

Radio-Electronics

ELEVISION • SERVICING • HIGH FIDELITY

A GERNSTBACK
PUBLICATION

oundup of stereo phono cartridges

R-E report on "amplified antennas"

Build a universal tape preamplifier



OKLAHOMA TENN 37388

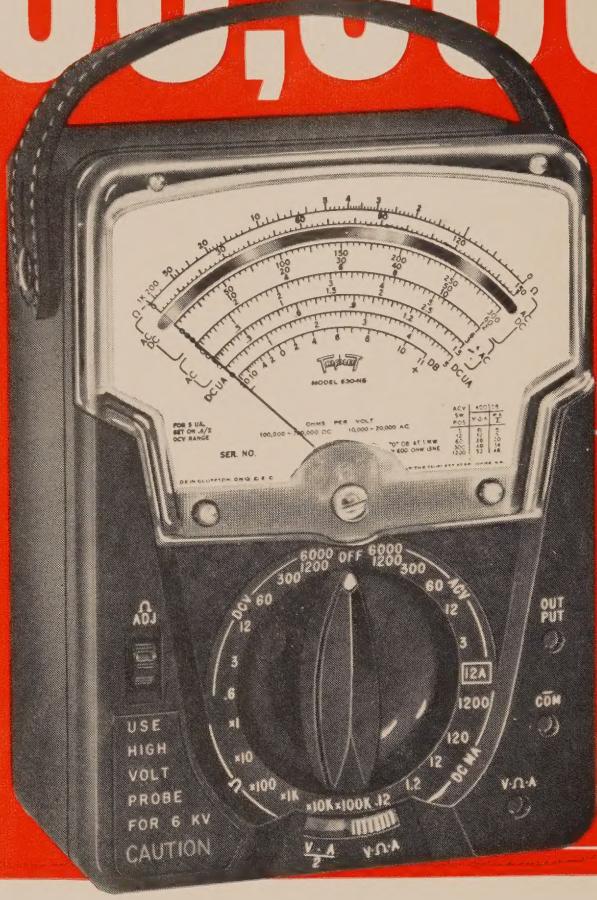
624 CIRCLE DRIVE
BOB G MARENHOFF 6-69

200,000 OHMS PER VOLT

NEW AND THE FIRST

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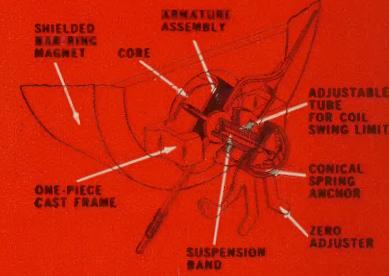
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Model 630-NS
VOLT-OHM-MICROAMMETER

TRIPPLETT SUSPENSION MOVEMENT

no pivots . . . no jewels . . .
no hair springs . . . thus **NO FRICTION**.



62 RANGES

D.C. VOLTS	0-0.6-3-12-60-300- 1200 at 100,000 Ohms/Volt. 0-0.3-1.5-6-30-150- 600 at 200,000 Ohms/Volt. 0-0.150 at 60μa
A.C. VOLTS	0-3-12-60-300-1200 at 10,000 Ohms/Volt. 0-1.5-6-30-150-600 at 20,000 Ohms/Volt.
DB	-20 to 77 in 10 ranges.
D.C. MICRO-AMPERES	0-5 at 300 MV. 0-60-600 at 150 MV. 0-120 at 300 MV.
D.C. MILLI-AMPERES	0-6-60-600 at 150 MV. 0-1.2-12-120-1200 at 300 MV.
D.C. AMPERES	0-6 at 150 MV. 0-12 at 300 MV.
OHMS	0-1K-10K-100K (4.4-44-440 at center scale)
MEGOHMS	0-1-10-100 (4400-44-4000- 440,000 Ohms center scale)

OUTPUT: Condenser in series with A.C. Volt ranges.

TRIPPLETT ELECTRICAL INSTRUMENT COMPANY, BLUFFTON, OHIO



THE WORLD'S MOST COMPLETE LINE OF V-O-M'S. AVAILABLE FROM YOUR TRIPPLETT DISTRIBUTOR'S STOCK



Remote Console



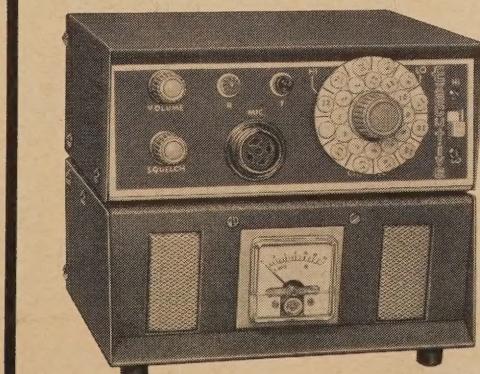
24-position switch, located on transmitter/receiver unit, is used for checking various circuits during tune-up or servicing.

**INTERNATIONAL
EXECUTIVE
750-HB2**

introducing

(with Built-in Test Circuits)

**INTERNATIONAL
EXECUTIVE
750-HM2**



Remote Console and Speaker Console. Two units may be "stacked" or installed separately.

It's totally new . . . a Citizens Band transceiver with built-in test circuits. Now at the "turn" of a switch, located on the transmitter/receiver unit, you can instantly check the operating performance of various circuits within the set. Makes tune-up and servicing easy. Checks filament, plate and input voltages, transmitter forward and reflected power, modulation, etc.

This "years ahead" built-in test feature has been incorporated into International's two new transceivers. The 750-HB2 with its functionally designed remote console* for desk-top installation, and the 750-HM2 for mobile communication. Both transceivers have 23 crystal controlled channels, and operate on 115 vac, 12 vdc, and 6 vdc.

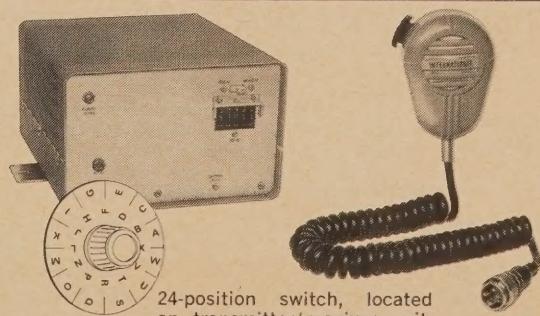
NEW Built-in test circuits. **NEW** Delayed/Expanded AVC. **NEW** Simplified cabling. **NEW** Built-in S/Meter and Transmit/Meter as standard equipment. **NEW** Microphone with improved characteristics for better "close talk" quality. **NEW** Speech Clipper/Filter Amplifier.

*Base station remote console available separately. Ask for RMO-24 HB2

See the 750-HB2 and 750-HM2 at your International dealer today! Ask him about his trade-in/trade-up plan.

**INTERNATIONAL
CRYSTAL MANUFACTURING CO., INC.**

18 NORTH LEE • OKLAHOMA CITY, OKLA.



24-position switch, located on transmitter/receiver unit, is used for checking various circuits during tune-up or servicing.

Radio-Electronics

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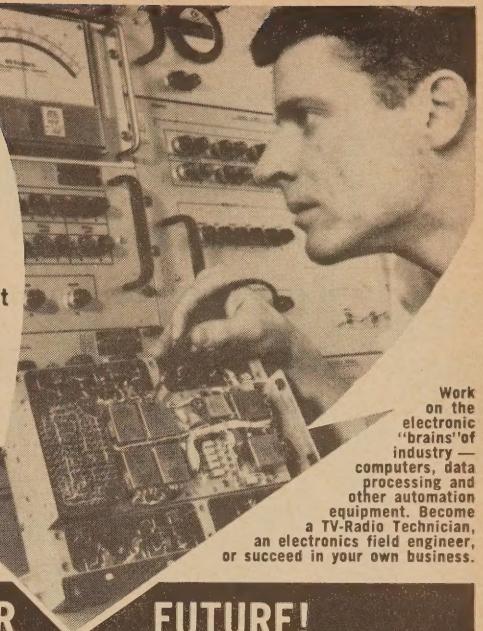
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Dept.
RG-104

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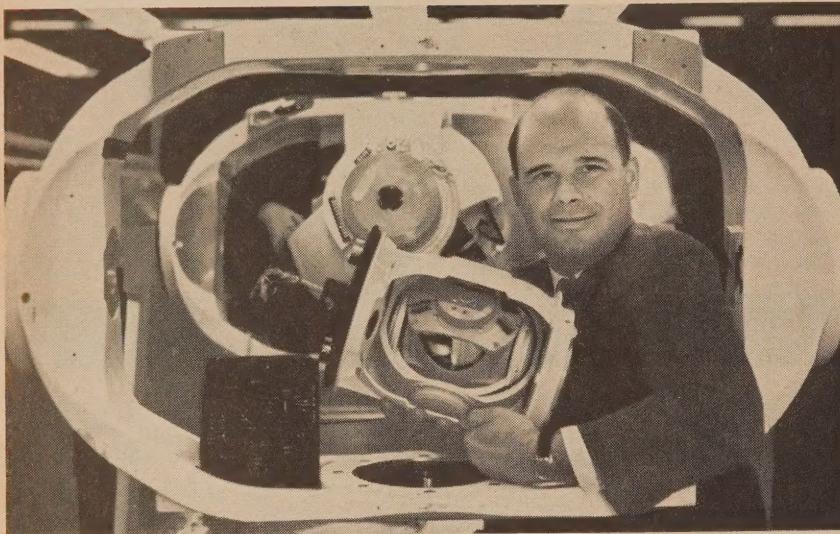
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NEWS BRIEFS



Sperry engineer Clinton Burdick with the gyroscopic heart of the new Sperry SGN-10 Inertial Navigation System. He is framed in the gimbals of a large gyroscope of the type used aboard submarines.

INERTIAL GUIDANCE ADOPTED ON PAN-AMERICAN AIRWAYS

Pan-Am's entire fleet of 48 Boeing 707 jet aircraft and seven Boeing jets on order will be equipped in 1965 with Sperry's inertial navigation and guidance system, according to a joint announcement of Pan-American Airways and Sperry Gyroscope Co. (See "Inertial Guidance Directs Planes and Missiles," RADIO-ELECTRONICS, December, 1958, page 56, for a full explanation of the technique.)

The inertial navigational system is based on three gyroscopes at right angles to each other. They maintain a stable platform, absolutely steady in relation to the earth.

On this stable platform are mounted accelerometers to measure acceleration in the forward or sidewise direction. An amplifier builds up the signals supplied by the accelerometer and feeds them to a computer which continuously tells the pilot his position, time, distance to destination and ground speed. The pilot need only feed in the latitude and longitude of the point of departure and of the destination. All navigational and guidance functions are then handled by the inertial system.

Inertial navigation has been used by military aircraft and by ships. Navy nuclear submarines met at the North Pole under ice by using inertial naviga-

tion. Polaris missiles are also guided by this system. This is the first large-scale use of inertial navigation in commercial aircraft.

FCC TIGHTENS CB RULES TO ELIMINATE HAMMING

Noting that the trend is for many CB'ers to use their stations for hobby-type operations, the FCC adopted a Report and Order amending Part 95 (formerly Part 19) of its Rules to clarify the permissible and prohibited uses of CB (principally class-D) stations. The rule changes are effective Nov. 1.

Some of the significant provisions of the amended Rules emphasize that:

1. The primary purpose of the class-D authorization is as a means of communication between units of a single licensee.

2. Communication between units of different licensees (interstation) is permitted only under certain stated conditions (Part 95.81) and is restricted to channels 9, 10, 11, 12, 13, 14 and 23.

3. Interstation communications are limited to not more than 5 consecutive minutes with a silent period of at least 5 minutes before another transmission is permitted.

A new section, which spells out various prohibited uses, has been adopted in the Rules. Some of the prohibited practices are:

1. Interstation communications relating to technical performance, capabilities, testing of any transmitter; including transmission of signal-strength and frequency-stability reports.

2. Communications to another station over a distance of more than 150 miles. (The commission notes that this new limit is far beyond the normal ground-wave distance of 25 miles.)

3. Persons selling CB equipment shall not allow customers to operate under the seller's station license.

All CB licensees are now required to maintain a current copy of Part 95 of the Rules. Licensees may obtain a current copy and a subscription to subsequent changes from the US Government Printing Office, Washington, D.C. 20402.

RADIO TRANSMITTER STABILIZED BY BODY HEAT



Crystal case (model's left hand) goes in armpit to keep temperature and frequency constant.

A continent-spanning radio transmitter that weighs 10 ounces including batteries uses body heat for frequency control. It was developed by James G. Arnold, engineer of RCA's Communications Systems Div., at Tucson, Ariz.

The user places a miniature metal container, linked to the transmitter and containing frequency-determining crystal elements, under his upper arm for temperature stability. Great distances are spanned by using the stable high-frequency skywave medium and ex-

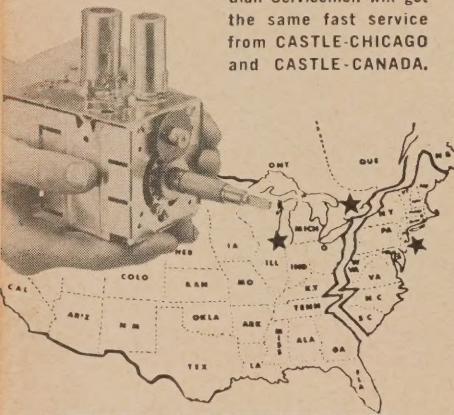
NOW, MORE THAN EVER...

THE FINEST SERVICE IN TV TUNER OVERHAULING

CASTLE TV TUNER-EAST HAS MOVED TO NEW LOCATION WITH IMPROVED FACILITIES

In Long Island City near Postal Concentration Center to provide faster service by mail.

All other U.S. and Canadian Servicemen will get the same fast service from CASTLE-CHICAGO and CASTLE-CANADA.



ALL MAKES
ALL LABOR
AND PARTS
(EXCEPT TUBES)*
ONE PRICE

995

ONE LOW PRICE INCLUDES ALL UHF,
VHF AND UV COMBINATION* TUNERS

Simply send us your defective tuner complete; include tubes, shield cover and any damaged parts with model number and complaint. 90 Day Warranty.

Exact Replacements are available for tuners unfit for overhaul. As low as \$12.95 exchange. (Replacements are new or rebuilt.)

*UV combination tuner must be of one piece construction. Separate UHF and VHF tuners must be dismantled and the defective unit only sent in.

Pioneers in TV



Tuner Overhauling

CASTLE TV TUNER SERVICE, INC.

EAST: 41-96 Vernon Blvd., Long Island City 1, N.Y.
MAIN PLANT: 5715 N. Western Ave., Chicago 45, Illinois
CANADA: 136 Main Street, Toronto 13, Ontario

*Major Parts are additional in Canada

tremely narrow-bandwidth reception. This requires a highly stable transmitting frequency.

Mr. Arnold pointed out that, beyond emergency uses such as by downed pilots and shipwreck survivors, the little transmitter is believed to fill communications needs of Peace Corps members, missionaries, explorers, surveyors and others in distant and solo travel.

CITY'S "HEARTBEAT" RECORDED ELECTRONICALLY

In collaboration with the Alexandria, Va., Health Department, Honeywell Inc. has developed a 7-lb. battery-operated electrocardiograph, called Cardioview, used to check patients' hearts in their own homes and relay the data by telephone to an evaluating station.



Alexandria Health Dept. public health nurse visits 13-year-old rheumatic fever victim. Electrodes of Honeywell Cardioview are strapped to youth's ankles and wrists to sense electrical signals of heartbeats. Nurse dials number of Public Health Service Instrumentation Field Station in Washington, D.C., to start recorder automatically. Data transmission takes place via Data-phone converter (right, with telephone handset), which puts electrical signals into transmittable form.

A magnetic tape system at a receiving station in Washington records the electrocardiograms. About 500 citizens of Alexandria, some with known heart diseases, are having their electrocardiograms phoned via Bell System Dataphone into the Public Health Service's Instrumentation Field Station.

General manager W. D. Owens of Honeywell's Denver Div. says, "Of even greater significance is the promise the

CALENDAR OF EVENTS

First National Conference on Automotive Electrical & Electronics Engineering, Sept. 22-23; McGregor Community Conference Center, Wayne State University, Detroit, Mich.

Third Electronic Trade Exhibition, Sept. 23-29; Apollohall, Amsterdam, Holland.

New York High-Fidelity Music Show, Oct. 1-4; New York Trade Show Building, New York, N.Y.

International Space Electronics Symposium, Oct. 6-9; Dunes Hotel, Las Vegas, Nev.

16th Annual Fall Convention and Exhibition of Professional Products, Audio Engineering Society, Oct. 12-16; Barbizon-Plaza Hotel, New York, N.Y.

British Industrial Exhibition, Nov. 2-14; Peking, People's Republic of China

20th Annual National Electronic Conference, Oct. 19-21; McCormick Place, Chicago, Ill.

systems techniques used in the survey hold for transmitting, recording and analyzing a wide variety of physiological data, such as brain waves and blood-pressure curves, that aid importantly in medical diagnoses."

ELECTRONIC DEWPOINT METER

A meteorological dewpoint meter that uses thermocooled semiconductors and thermistor temperature measurement has been produced in Britain. (Dewpoint is the temperature at which air containing a certain amount of moisture can no longer hold that amount, and some condenses out.)

When dew forms on the mirror, a light from a stabilized voltage supply is scattered on a light-sensitive cell, which cuts off the current to the thermomodule used to cool the mirror. When the dew clears, the light no longer strikes the cell, and the cooling device operates again. So the mirror surface continually cycles between dew and no-dew conditions and is never cooled below dewpoint temperature. The meter gives ambient temperature within 3 seconds after it is turned on, and dewpoint temperature within 30 seconds, to an accuracy of $\pm 0.25^\circ\text{C}$.

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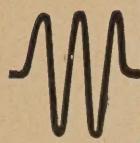
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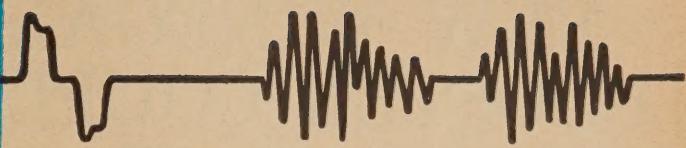
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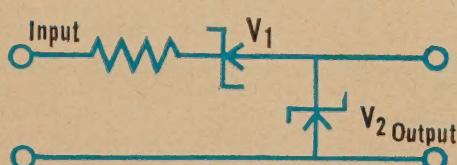
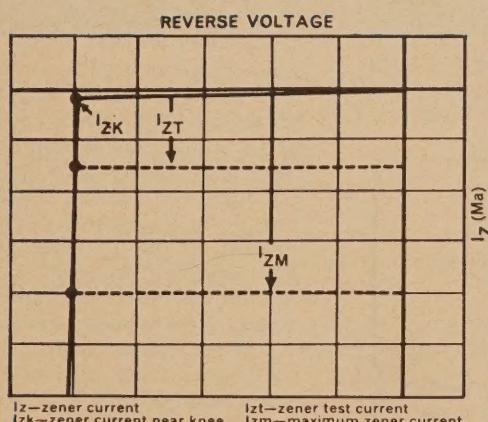
MALLORY



Tips for Technicians

Mallory Distributor Products Company
A division of P. R. Mallory & Co. Inc.
Indianapolis, Indiana 46206

New Kind of Zener Diode



Typical shunt overvoltage protection circuit using zener diodes. Output is controlled between V_1 and V_2 .

A zener diode, as you're probably aware, is a special kind of semiconductor which has excellent voltage regulating characteristics. It's the solid-state successor to the gas discharge tube. It acts like a rectifier diode, blocking current in the reverse direction, until the "zener voltage" is reached—then it starts to conduct with a capital C. The zener diode can carry appreciable current continuously. So this makes it a fine regulating device. You can use it in power supplies where you need highly accurate output. Or you can use it in clipper or clamper circuits, by biasing the diode negative.

The big news in zener diodes is that you can now get them from Mallory at a price which makes them practical for service work, experimentation, or commercial circuitry. The news-maker is the new Mallory Type ZA molded-case diode. Its electrical properties and reliability record are comparable to those of military grade units. In fact, we use the same silicon cell in the ZA as in the zener diodes we make for military requirements. But the price is only about half that of hermetically sealed diodes.

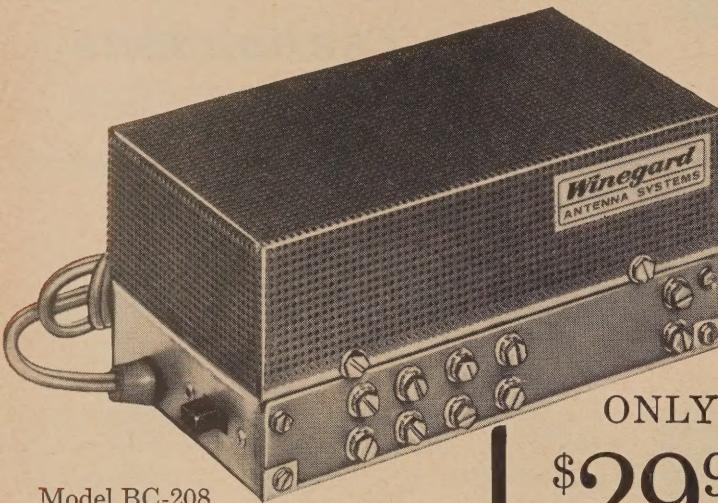
The ZA is rated 1 watt at 25°C. If you install it in a hot spot, you can use it at ambients up to 100°C, derating linearly to 0.5 watt. Voltage ratings go from 6.8 to 200 volts, in small increments so that you can get exactly the regulating voltage you need. Standard tolerances are 20%, 10% and 5%.

You'll like the cold-case design of the ZA. No need for insulating sleeves when you squeeze it into tight layouts. It's so small—only $\frac{3}{8}$ " long by 0.220" in diameter—that it fits practically anywhere.

Your Mallory distributor has the Type ZA in a range of ratings. He also stocks Mallory silicon rectifiers... including handy packaged doubler, bridge and center-tap circuits. See him soon!

a big improvement on an old favorite...

NEW WINEGARD BOOSTER COUPLER



Model BC-208

*Runs 1 to 4 TV or FM sets
Replaces Model WBC4-X*

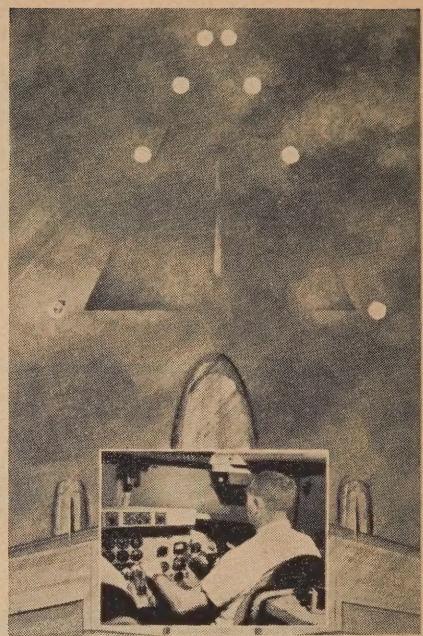
ONLY
\$29.95
LIST

**Boosts Signal... Cuts snow...
no picture smear... no interac-
tion... 8 DB gain to each out-
put.**

Winegard engineers have taken ad-
vantage of the newest ampliframe
shielded triode tubes to develop
an improved booster-coupler. The
new BC-208 uses two 6HA5 tubes

for higher gain and less noise. FM
gets a boost, too, in this new cir-
cuit as it covers the entire FM
band 88-108MC. It's a great new
product from Winegard for better
color, black & white or FM re-
ception. Ask your distributor or
write today for spec. sheets. Check
the comparison chart against the
old Winegard Booster Coupler.

	BC-208	WBC4-X
Number of tubes	2 6HA5	1 6DJ8
Gain to each isolated output	+8db	+5.8db
Gain across FM Band	+7db	+1.2db
Noise Figure, Low Band	3.7db	3.8db
Noise Figure, High Band	5db	5.2db
Isolation between outputs	18db	8db
Signal Input	20 to 350,000 microvolts	20 to 300,000 microvolts
Maximum Signal Output	1,800,000 microvolts	1,500,000 microvolts
ON-OFF Switch	Yes	Yes
Response	Flat $\pm \frac{1}{2}$ db per any 6mc channel	Flat $\pm \frac{1}{2}$ db per any 6mc channel
No-strip terminals	Yes	Yes
Removable mounting bracket	Yes	No
Module wiring	Yes	No
Number of isolated outputs	4	3



*How the Bendix Microvision beacons would
outline an airport runway, shown as partially
obscured by fog. The larger picture shows the
windshield with the dots superimposed on it by the
apparatus through which the
pilot is looking (insert). Each dot is pro-
duced by an electronic beacon close to the
runway. If the runway is completely
obscured, the pilot could guide the plane
down with the help of the dots alone, until
the actual runway came into view.*

ALL-WEATHER LANDING DEVICE BRINGS RUNWAY INTO COCKPIT

A landing aid that shows an elec-
tronic image of an airport runway posi-
tioned directly over the real-life runway
has been announced by Bendix. The
device puts a series of bright dots on a
semitransparent screen positioned di-
rectly in the pilot's regular line of vision.
Thus he is able to check up on how well
his automatic landing system is taking
him down the approach path. He can
then maneuver the plane into the cor-
rect position if necessary so that he will
not have to make adjustments when the
strip itself becomes visible.

The system, called Microvision,
uses pulses from a number of micro-
wave transmitters placed on each side of
the runway. It has been completely test-
ed at several airports and submitted to
the Federal Aviation Agency for ap-
proval.

TWO-WAY MOONBOUNCE

The first ham trans-Atlantic com-
munication on 432 mc took place on
June 13 between Dr. Gordon Pettengill,
KP4BPZ, Arecibo, Puerto Rico, and
Dr. Hans R. Lauber, HB9RG, Zurich,
Switzerland. Dr. Pettengill established
communications the same weekend
with hams in England and Germany,
and in Wisconsin, Colorado, Massachu-
setts and other states.



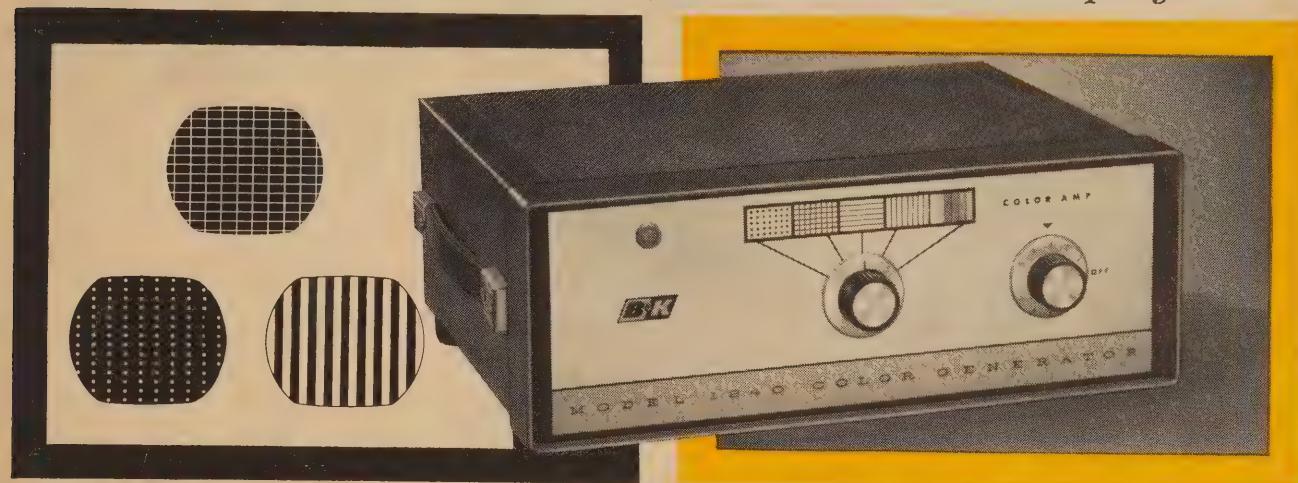
Winegard Co.
ANTENNA SYSTEMS

3013-J KIRKWOOD, BURLINGTON, IOWA

NOW
convergence and color adjustments
are easier, faster, more accurate!

NEW B&K MODEL 1240 LOW PRICED PORTABLE COLOR GENERATOR

with crystal-controlled keyed rainbow color display!



Thinnest Horizontal Lines! Smallest Visible Dots!
(Just one raster scanning line thick)

only

Simplifies In-Home (or Shop)
Color TV Set-Up and Servicing

\$134⁹⁵_{NET}

You're the color TV expert when you use the "1240." You have the advantage of B&K quality—with features not available before at such surprisingly low cost.

Provides crystal-controlled keyed rainbow color display on TV screen to test color sync circuits, range of hue control, and align color demodulators. Shows ability of TV receiver to display color values.

Provides dot pattern, crosshatch, horizontal and vertical lines. Highly stable crystal-controlled count circuit with small-step count assures greater reliability and stability of color, dots, and lines. All horizontal lines and

dots are just one raster scanning line thick. Lines begin off-screen and end off-screen, with no break in line. Dot brightness is adjustable with easily accessible control. Chroma Level Control simplifies color sync trouble-shooting.

Operates on channels 3, 4, and 5, and adjustable without removing cabinet. No connection inside TV set is needed. Power transformer operated and line isolated to prevent shock hazards. Operates reliably on 105-125 VAC, 60 cps. (Color Gun Killer is available as optional accessory.) Extreme lightness and portability (9 lbs.) make it ideal for in-home servicing.



*See it at your B&K Distributor
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**"Believe it or not,
I make over 90% of
my broadcast tapes
on the same Norelco
model designed for
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says Skip Weshner**



"My tapes have to meet the broadcast standards of the leading FM stations around the country, whose other taped programs are normally recorded and played back on professional broadcast-studio consoles. My Norelco '401' gives me tapes that not only meet or exceed these standards, but on playback on the '401' I defy any listener to tell the difference between my live broadcasts and my taped ones!"

"As to reliability, my Norelco has been on the firing line five nights a

week, month after month, year after year, and has required less maintenance than any other recorder I've ever used. It handles tape more gently, too: it doesn't break tape, it doesn't spill tape, it doesn't stretch tape—not even the half-mil stuff I'm forced to use to get an hour's broadcast on a 7" reel.

"Although the '401' was designed for the operating convenience and for the pocketbook of the home user, in my book it has proved itself as a thoroughly professional instrument."

The Norelco Continental '401': 100% transistorized • 4-speed • 4-track stereo/mono, record/playback • completely self-contained with dual preamps, dual power amplifiers, two wide-range stereo-matched speakers and stereo dynamic microphone. (Two broadcast quality microphones can be used with simple adapter.)

At your hi-fi dealer's—or write to Dept. S-10, North American Philips Company, Inc., High Fidelity Products Division, 100 East 42nd Street, New York, N. Y. 10017



Norelco®

Hams, by law, use less than 1,000 watts of transmitter power, but antennas may be massive. For moonbounce, they have an automatic tracking mechanism timed to coincide with the movements of the earth and moon to keep the signal on target. Arecibo's antenna is hemispheric, 1,000 feet in diameter. (RADIO-ELECTRONICS, Feb. 1964, P. 36.)

A LASER FOR SECRETARIES?



Stanford Prof. Arthur L. Schawlow demonstrates the principle of the laser eraser with his low-energy laser toy gun, which will burst the dark inside balloon, but not the clear outside one.

Stanford Physics Prof. Arthur L. Schawlow, who first proposed the laser, has thought up a new one—the "laser eraser." "Why not a laser eraser key on electric typewriters?" asked Prof. Schawlow. The split-millisecond light pulses, he found, removed individual letters as if they had never been typed. The intense, instantaneous heat vaporized the typewriter ink, yet left the paper completely unmarked.

TAPE RECORDS NATIONAL MEET

Two thousand Boy Scouts served as regional reporters at the National Boy Scout Jamboree at Valley Forge, Pa., and recorded their observations each day on 3-inch reels of tape. These were mailed daily to some 3,000 radio stations in the scouts' home towns across the nation. Master "Report from the '64 Jamboree" tapes on 7-inch reels were recorded for each region represented at the gathering, which numbered 53,000 scouts and their leaders.

Representatives of 3M's Revere-Wollensak and Magnetic Products divisions were on hand with technical information.

GAS LENSES FOR LASERS

Laser beams may be guided in pipes by lenses made of gas, according to Bell Labs' scientists Dwight W. Berman and Andrew R. Hutson. The advantage of gas for lenses is that gases do not reflect or absorb light as much as conventional optical materials.



WIN THIS GREAT
NEW SPORTS CAR!

Photo Courtesy Ford Motor Co.

ENTER THE BIG PHOTOFAC[®] "WIN-A-MUSTANG" CONTEST!

**EVERYONE WHO ENTERS
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(as illustrated)

SECOND PRIZE

Luxurious Mink Stole

THIRD PRIZE

Ladies Elgin Diamond Wrist Watch

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special gift just for entering
this PHOTOFAC[®] contest...**

Contest period is open between September 1, 1964 and December 31, 1964. Entry forms are available from your Sams Distributor or from Howard W. Sams & Co., Inc. (only one entry per contestant accepted). All you do is fill out the entry form, and have it validated by your Distributor. Winners will be determined by a drawing. (Contest limited to U.S.A.; not valid where prohibited by State or local laws.)

**DRAWING WILL BE HELD ON
JANUARY 15, 1965**

winners will be notified

YOU'RE ELIGIBLE IF YOU USE PHOTOFAC[®]
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The contest is open to everyone who: 1—is a subscriber to PHOTOFAC[®] or one of the new PHOTOFAC[®] Specialized Series—or 2—owns a PHOTOFAC[®] Library of 60 or more Sets. There is nothing to do except fill out the entry form. Everyone has an equal chance to win at the drawing. Contest closes December 31, 1964, and all entry forms must be postmarked before January 1, 1965. Enter this worthwhile contest now!

**GET YOUR ENTRY FORM FROM YOUR
SAMS DISTRIBUTOR OR SEND COUPON**

**DO IT
TODAY!**

**HOWARD W. SAMS & CO., INC., Dept. REF-10
4300 W. 62nd St., Indianapolis, Indiana 46206**

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INDIANAPOLIS, INDIANA 46206**





An experimental gas convection lens. Coils around the pipe keep it at constant temperature. A helix heater inside the pipe causes convection currents that produce an average increase of density along the pipe's axis, giving it properties of a lens.

Gas lenses can be produced in one of two ways. A helix running down the center of the pipe may be heated a few degrees warmer than the pipe. This sets up nonturbulent convection currents that cause the gas to concentrate in the center of the pipe, varying the index of refraction as the center of the pipe is approached, and giving the gas the quality of a lens.

Another type of gas lens is made by flowing two gases with different refractive indices from opposite directions through a short section of pipe or mixing chamber. The gas with the higher refractive index flows in the center of the pipe, that with the lower index at the edges.

The gas lens has an additional advantage in that in curved sections of pipe it has a tendency to bring the beam back toward the center of the pipe automatically.

RAYMOND V. PEPE DIES

Raymond V. Pepe, chairman and former president of the Institute of High Fidelity, died of a heart attack in Los Angeles on August 15, 1964. He was 52.

Culminating a long and fruitful career in the electronics industry, Mr. Pepe was also vice president of James B. Lansing Sound, Inc., Los Angeles.

BRIEF BRIEFS

General Electric announces a transistor portable television receiver for marketing this autumn. The set will have a 9-inch screen.

A major cause of space-flight failures and delays is electronic defects, delegates to the Armed Forces Communication & Electronics Convention were told by James E. Webb, administrator of the National Aeronautics & Space Administration (NASA).

New ultrasonic inspection device tests transistors by vibrating them at the tip of a steel reed, and listening at ultrasonic frequencies for rattles due to foreign particles, detached leads, or leads rubbing together. The ultrasonic particle detector was developed by Delcon Corp., Palo Alto, Calif.

Engineers at the National Bureau of Standards have developed a circuit using a photoelectric cell to protect transmitting klystrons from heater underload and overload. The photocell responds to the light from a control lamp in the klystron heater circuit, cutting off power if heater voltage falls below tolerance.

The first medical educational program over subscription TV was shown on Channel 18 in Hartford, Conn. The first subject discussed was "Hyperbaric Oxygen and Its Applications." END

FREE NEW 1965 GIANT CATALOG

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INDEX PAGE 226. PHONE BALTIMORE 1-1160
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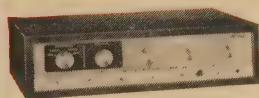
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\$79.95
less case

KG-854 54-Watt Solid-State Stereo Amplifier Kit—absolutely superb performance, a pleasure to build. No output transformers; precision self-resetting circuit breakers; printed circuit board and military-type terminal board for easy assembly. Nothing like it at the price!



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KG-765 All-Transistor Stereo FM-AM Tuner Kit—delivers the most exciting stereo sound imaginable. Features automatic stereo MX indicator light; FM-AM signal-strength tuning meter; factory-assembled and aligned IF strip and FM front-end. Superb quality— incomparably low in cost.



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C-560 5-Watt CB Transceiver Kit—for 110-130 v. AC/12v. DC; terrific sensitivity; 6-crystal-controlled channels; 23-channel manual tuning; preassembled and tuned Nu-vistor RF stage; solid-state power supply; 2-stage IF; adjustable squelch, and much more. A super-value in latest CB design.

\$15.88



KG-275 Exposure Meter Kit—latest super-sensitive cadmium-sulphide type; accurately measures both reflected and incident light; 2-range meter; push-button selection for low and high light levels; color-coded scales to calculate proper lens opening and shutter speed. Professional quality—outperforms far costlier units.

\$34.95
with switchable probe



KG-625 6" VTVK Kit—king-sized for accuracy; 1/2-volt full-scale DC range; 200 microamp movement; reads peak-to-peak AC volts directly; precision 1% film-type resistors; single switchable AC-ohms/DC test probe. Terrific value.

\$49.95
with cable & leads



KG-375 Universal Auto Analyzer Kit—great for auto tuneups—checks generator, alternator, regulator, wiring, both 6 and 12-volt, all engines. Big 7" meter; solid-state circuitry; self-powered. Packed with exclusive features—at lowest cost.

\$19.95



KG-225 Wireless Intercom Kit—transistorized and wireless—newest, finest, most advanced intercom kit you can buy. All units are Masters; all originate calls. Squelch circuit eliminates interference. Add stations as needed. Amazingly low priced.

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KG-870 70-Watt Solid-State Stereo Amplifier Kit—packed with dozens of deluxe features to bring you spectacular performance at low, low cost. The last word in easy assembly and breathtaking sound.



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C-22 5-Watt CB Transceiver Kit—top quality at lowest price; for 110-130 v. AC/12 v. DC; 5 crystal-controlled channels, 22-channel manual tuning; adjustable squelch; ANL; Pi-net output, and more.



\$39.95
"Star Roamer" 5-Band Superhet Short-Wave Receiver—band-switched ranges; electrical bandspread; "S" meter; ANL; IF sensitivity control—tops for lowest-cost world-wide radio reception.



\$99.95
T-150A 150-Watt AM/CW Transmitter Kit—covers 80 through 10 meter ham bands; controlled-carrier modulation; stable VFO; "spot" switch; chirp-free cathode keying; front panel key jack. The price is unbeatable.



\$8.88
less battery

Famous C-100 Walkie-Talkie Kit—all-transistor; range up to 1/4 mile; crystal-controlled transmitter for channel 7; fun to build and use. Owned by thousands. Lowest-priced Walkie-Talkie kit available anywhere.



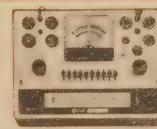
\$24.95
with leads

KG-620 4 1/2" VTVK Kit—ranges each, AC v. (RMS & P-P), DC v., ohms, and db. 11 megohm input. Extended response — +1 db, 30 cps to 3 mc. Easy-reading 2-color meter scale. A dollar-stretching value.

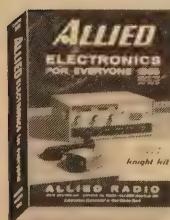


\$19.95

Transistorized Electronic Tachometer Kit—registers 0-8000 rpm, with 3% full-scale accuracy; Zener diode regulation; universal mount. Rugged; reliable. Tops in value and performance.



\$35.95
600-B Tube Tester Kit—tests over 2300 types; checks for quality, continuity, shorts, open elements and gas; cathode-emission type; fast setup. Excellent value.



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Correspondence

lection of early radio and wireless sets. I would like to add to my collection, so if any of your readers want to dispose of pre-1925 radios, catalogs, booklets, etc., I would like to buy or trade other gear, ancient or modern.

PHIL WEINGARTEN

67-61 Alderton St.
Forest Hills 74, N.Y.

STROBE LIGHTS ARE DEADLY

Dear Editor:

Wayne Lemons' article "Servicing Speedlights" (page 50, August '64) is complete in the areas it covers, but it does not cover the complete range of

electronic flash equipment on the market. For instance, only one type of low-voltage speedlight equipment (Stroboflash) and only one type of high-voltage equipment (Photogenic) are discussed.

The danger in servicing photoflash can never be overstressed. The italicized statement on page 51, ". . . A speedlight can kill you!" should appear in very large letters at the beginning of the article.

How many service technicians still observe the basic safety precautions they learned during their education? Keeping one hand off the equipment and never working alone may be extravagant when working on a TV set (though always wise), but is essential when working with equipment that can deliver up to 1,000 amperes at 2,000 volts.

Even the least dangerous piece of electronic flash equipment Mr. Lemons writes about can not only make loud noises when discharged suddenly by shorting its capacitors, but can kill you when you are part of the circuit. In the Stroboflash, for example, there is no bleeder to discharge the capacitors automatically, nor is there any visual indication that they are charged.

One piece of equipment on the market uses fourteen 500- μ F capacitors in series-parallel. Almost all its circuitry is etched-type, with all foil exposed to the touch when the case is opened. (This unit *does* discharge all capacitors when the power is shut off.) A technician who works on it for the first time may discover that one corner of the board has not been too thoughtfully laid out. A little slip of a test prod there will not only give him ringing ears and an upset stomach for hours, but will copperplate (with molten foil) everything in the vicinity.

I don't say that the radio-TV repairman should turn down flash servicing, but he should understand that the equipment can be extremely dangerous and often looks deceptively simple.

By the way, there are some firms in the country—such as our own—that specialize happily in servicing electronic flash.

W. J. PAWLowski

*Strobe Masters
New York, N.Y.*

HEY! WE MUST BE PRETTY GOOD!

Dear Editor:

I have been a RADIO-ELECTRONICS reader for many years. During this time I have constructed many of the circuits, all of them have worked to perfection. This dependability is deserving of my sincere thanks. I keep RADIO-ELECTRONICS on file in my hobby shop.

R. WAYNE HENDRICKSON
Poway, Calif.

WANTS ELECTRONIC MEMORABILIA

Dear Editor:

I have a complete set of *Radio News* magazine, and quite a nice col-

A NEW CONCEPT IN COLOR TV ANALYZING PUTS YOU IN THE PROFITABLE COLOR TV SERVICE PICTURE AT A VERY LOW COST

Model 900 COLOR TV ANALYZER

- Checks color, video and picture tube circuits
- Checks the overall performance of color TV sets
- Provides for fast purity, convergence and gray scale tracking adjustments

Color TV set sales are booming all over the country! To help progressive servicemen get their share of the color service business Mercury has developed a highly efficient instrument based on an ingenious new engineering concept in color TV analyzing. The Model 900 Color TV Analyzer enables you to tackle color TV servicing in the home and in the shop with ease and confidence at a minimum cost.

FEATURES

- ✓ Makes all tests dynamically while color set is in operation
- ✓ Exclusive circuit eliminates need of range switches. Just set element selector and meter is automatically on right range
- ✓ Connects as easily as a picture tube brightener... no need to get under TV chassis
- ✓ Safety feature... circuit allows safe measurement up to 7000 volts on focus grid

See your electronics parts distributor or write for complete Mercury catalog

\$44.95 Slightly higher in the West

NEW

MAKE ANY ONE OF THESE TESTS IN MINUTES

- TEST each control grid voltage... indicates shorts or gas in each color gun
- TEST each color gun screen voltage and screen current... indicates trouble in power supply or boost circuits
- TEST focus voltage... indicates high voltage or horizontal deflection circuit trouble
- TEST each cathode voltage... indicates circuit trouble
- TEST each control grid emission current... indicates shorts or gas in each color gun
- TEST each color gun cathode emission... indicates dynamic quality of each color gun.

The Model 900 enables you to cut-out color guns in any combination and adjust for proper PURITY—CONVERGENCE—and GRAY SCALE TRACKING.



ELECTRONICS CORPORATION

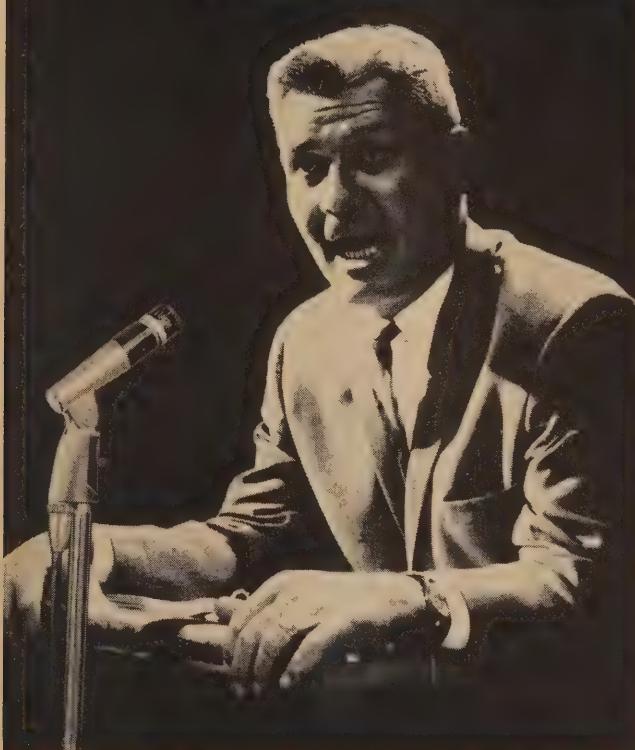
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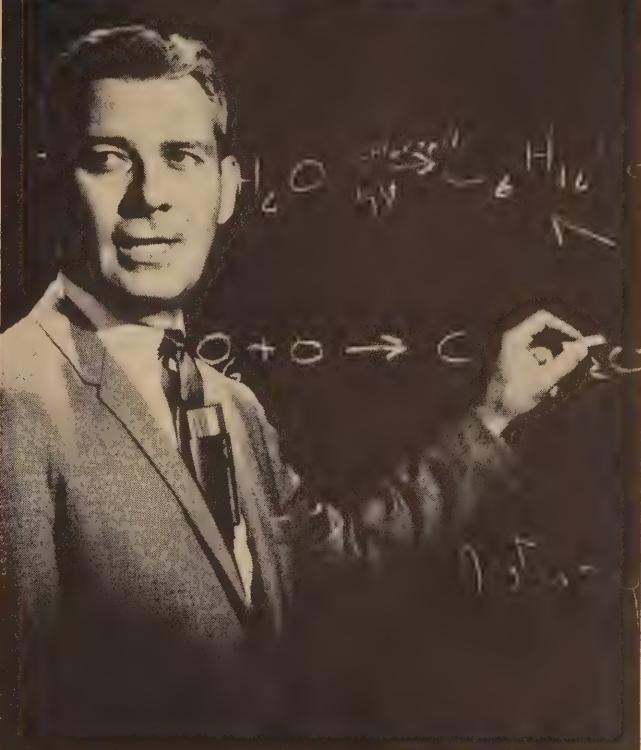
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types of microphones



...GET THIS LAVALIER FOR ONLY \$5.00

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This special limited-time offer applies to the famous Unidyne II and III series and other fine Shure microphones listed below.* Unidyne III is the only cardioid microphone with pick-up pattern symmetrical about axis and uniform at all frequencies. Outstanding for voice or instruments.

*Models 300, 315, 330, 333, 55SW, 55S, 545, 545S, 546, 556S, 576, 578, 578S. A Shure Lavalier for only \$5.00 with each, when you send in your guarantee registration card. Offer expires December 31, 1964.



For lecturers, teachers, ministers, managers, public speaking requires the freedom and flexibility of a second microphone. The ability to move around while talking frees the speaker for writing on a blackboard or handling visuals, makes any speaker more interesting, more effective. Prove it to yourself for only \$5.00 when you buy a Shure Microphone for fixed-location use.

Steps to obtain your Lavalier Microphone:

Purchase any of the microphones listed above thru your distributor or sound installer.

Remove guarantee registration card from microphone package. Specify whether you wish high impedance or low impedance lavalier microphone in the comment section of guarantee registration card.

Mail to Shure Brothers, Inc. with your check or money order for \$5.00. If sending cash please send by registered mail.

That's all there is to do. Your microphone will be sent to you post paid. Sorry, no C.O.D.s.

SHURE

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learning easier, more interesting, more meaningful. You get them all from NRI.

Whatever your interest . . . whatever your need . . . whatever your education . . . pick the field of your choice from NRI's 10 instruction plans and mail the postage free card today for your free NRI catalog. Discover just how easy and exciting the NRI 3-DIMENSIONAL METHOD of training at home can be. Do it today. NATIONAL RADIO INSTITUTE, Electronics Division, Washington, D.C. 20016.

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THE EASY NRI WAY—MAIL CARD TODAY**

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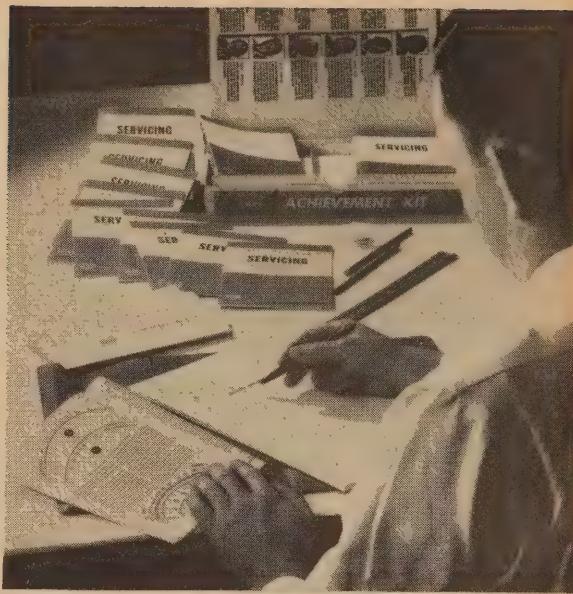


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Start Fast with NRI's New Remarkable Achievement Kit

The day you enroll with NRI this new starter kit is on its way to you. Everything you need to make a significant start in the Electronics field of your choice is delivered to your door. It's an outstanding way of introducing you to NRI training methods . . . an unparalleled "first dimension" that opens the way to new discoveries, new knowledge, new opportunity. The Achievement Kit is worth many times the small payment required to start your training. No other school has anything like it. Find out more about the NRI Achievement Kit. Mail the postage-free card today.



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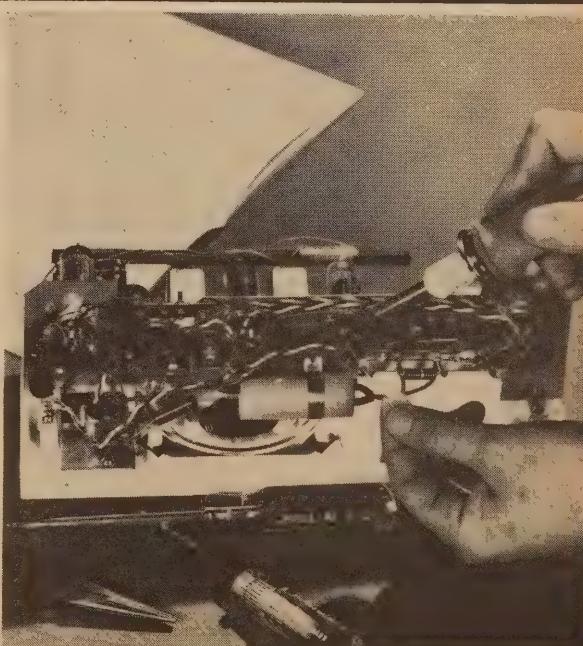
Certainly, lesson texts are a necessary part of any training program . . . but only a part. NRI's "bite-size" texts are simple, direct, well illustrated, and carefully programmed to relate things you read about to training equipment you build. Here is the "second dimension" in NRI's training method. Here are the fundamental laws of electronics, the theory, the training of your choice, presented in a manner you'll appreciate. And in addition to lesson texts, NRI courses include valuable Reference Texts related to the subjects you study, the field of most interest to you.



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Electronics becomes a clear and understandable force under *your* control as you get your hands on actual parts and build, experiment, explore, discover. Here is the "third dimension" . . . the practical demonstration of things you read about in NRI texts. NRI pioneered and perfected the use of training kits to aid in learning at home in spare time. *Nothing is as effective as learning by doing.* NRI invites comparison with equipment offered by any other school, at any price. Prove to yourself what three-quarters-of-a-million NRI students could tell you . . . that you get more for your money from NRI than from any other home-study Radio-TV, Electronics school. Mail postage free card for your NRI catalog. (No salesman will call.)



Assemble the finest instrument
your money can buy



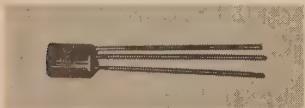
4 highlights of
musical superiority:



PIPE ORGAN VOICING—each separate and distinct—32 in Recital Model—LIBRARY OF STOPS™ Kit feature adds countless voices for instant plug-in.



PIPE ORGAN TONE—all four families of pipe tone in all models—Schober Organs are played like pipe organs—Recital Model built entirely to AGO specifications.



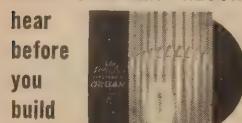
ALL-TRANSISTOR—Recital and Consolette II—instant response, easier assembly, longevity—full 5 year guarantee.



REVERBATAPE® Unit—adds depth and power to electronic organs—converts smallest living room into an "auditorium."

plus FULL THEATRE AND CHURCH VOICING, optional PERCUSSION, and many other quality features!

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NEW ALL-TRANSISTOR

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ORGAN

NEW SCHOBER ALL-TRANSISTOR RECITAL MODEL—sounds and plays like fine pipe organ—compares musically to instruments costing 4 times the price!

How is it possible to put so many superior musical features into every Schober Organ?

How is it possible to acquire the skill needed to build a splendid organ—without any previous knowledge of electronics or music?

While the completed organ is a complex instrument, the Schober Organ internal construction is especially designed for do-it-yourselfers. Thanks to printed circuitry the usual labor is eliminated and makes errors almost impossible. Many parts are supplied partially or fully assembled. For example, the keyboard with associated switches is supplied as an integral unit fully assembled. No woodworking is necessary—consoles come completely assembled and finished. You simply follow detailed illustrated instructions for easy assembly.

By saving the high cost of factory assembly and the usual retail store markup, you can put everything into the fine musical parts, and enjoy the finest instrument your money can buy.

Many who could well afford to buy *any* organ have chosen to build a Schober Organ simply because they prefer it musically.

Schober Organs are available in kit form from \$550—and you may purchase the complete set of kits, or you may spread the cost by ordering just the first unit for \$21.79. Send coupon to The Schober Organ Corp., 43 W. 61st St., New York, N.Y. 10023.

Schober Organ Kits are sold in the U. S. only by

THE *Schober Organ* CORPORATION

Dealers in principal countries.

The Schober Organ Corp., Dept. RE-33
43 West 61st St., New York, N.Y. 10023

Please send me, without cost or obligation, the Schober Organ Booklet with specifications of each model, details about Pointer System, 7-inch "sampler" record included FREE.

Enclosed find \$2 for high-quality LP 10" SCHOBER DEMONSTRATION RECORD which fully illustrates all three models with different kinds of music (\$2 refunded with purchase of first kit).

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ZIP NO. _____

[Aw, shucks! Thank you, Mr. Hendrickson. We must admit in all modesty that we have pulled off a few gassers from time to time. But we try to weed out all errors and ambiguities from our construction projects, test them thoroughly to be sure they do what they ought to, and make sure all the parts are readily available. If we do slip up, we try to run a correction notice in the issue immediately following. The corrections are also indexed along with the article in the June and December issues.

Lots of success with your next project!—Editor.]

IN SYMPATHY WITH "SERVICEMAN"

Dear Editor:

I am completely in disagreement with the action of the King County Television Service Association in the case of the man doing TV service from Fort Lawton. (See "Military Moonlighter Ordered to Halt", Technicians' News, Aug. 1964)

This man in military service gave up everything when he went in; his freedom, friends, job, place to work and instruments to work with. He might be demanded to give up his life. Can't you leave him a little something? He certainly can't be the competition he would be with his own shop and time to work. Since he seems to have some initiative and is willing to work instead of spending his time in taverns or gambling, let's give him a pat on the back, an apology and a little help so he can come out of the service a better man.

I spent enough time in uniform during World War II to know whereof I speak. Give the man a break. It is a very small thing we can do to show our appreciation for his large sacrifice.

WILLIAM R. LAITINEN
Minnetonka, Minn.

TRANSISTOR IGNITION A SUCCESS

(WELL, PRETTY MUCH . . .)

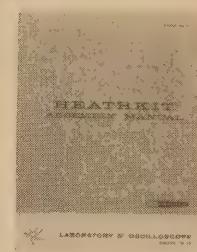
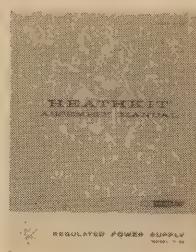
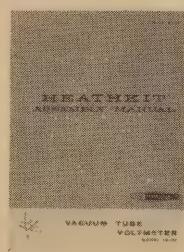
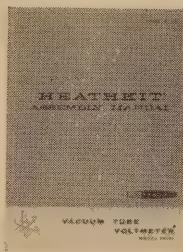
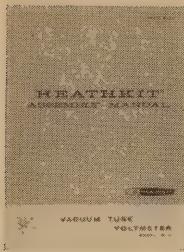
Dear Editor:

I recently installed on my 1963 6-cylinder Comet the transistor ignition system in the April issue of *RADIO-ELECTRONICS* ("Transistors Save Your Breaker Points", page 53). The results are as you indicated: better acceleration, idling and increased mileage. However, I did have two minor problems.

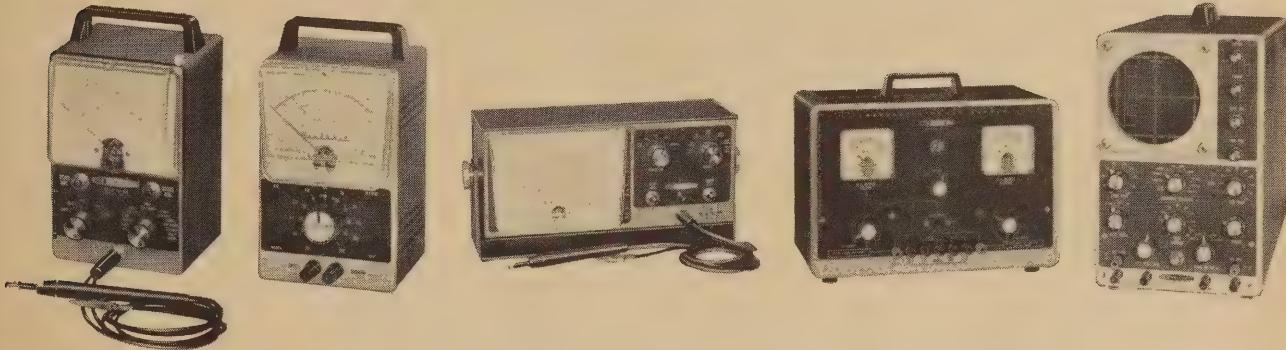
First, I wired the circuit as outlined in Fig. 4 of the original article. The engine started but the starter motor would not disengage. Having read the follow-up in your June issue, I corrected that easily.

After correcting that problem, I started the engine and when I turned the ignition off, the engine continued to run. It was necessary to disconnect a

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600 ohms), ten switch selected ranges from -40 db to $+50$ db in 10 db steps. Input impedance: 10 megohms shunted by 12 uuf on ranges 10 to 300 volts, 10 megohms shunted by 22 uuf on ranges $.01$ to 3 volts. Tube complement: (1) 6AW8, (1) 6EJ7/EF-184. Accuracy: Within 5% of full scale. Power requirements: 105-125 volts AC 50-60 cycles, 10 watts. Dimensions: $7\frac{3}{8}$ " H x $4\frac{1}{11}$ " W x $4\frac{1}{8}$ " D.

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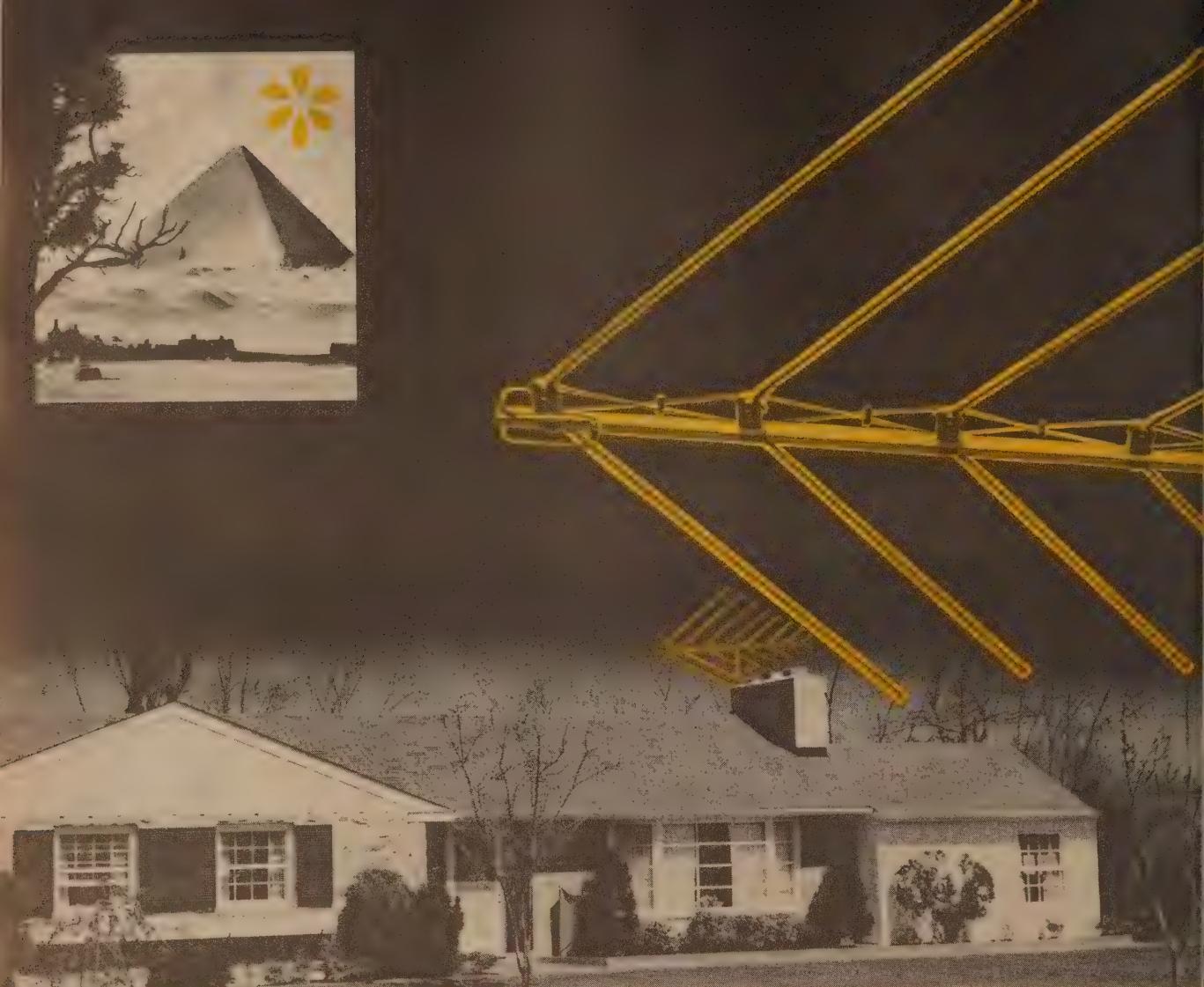
IO-12 SPECIFICATIONS— (Vertical) Sensitivity: 0.025 volts RMS per inch at 1 kc. Frequency response (referred to 1 kc level): ± 1 db 8 cps to 2.5 mc; ± 1.5 to -5 db, 3 cps to 5 mc; response at 3.58 mc, -2.2 db. Rise time: 0.08 microseconds or less. Input impedance: (at 1 KC) 2.7 megohms at X1; 3.3 megohms at X10 and X100. (Horizontal Channel) Sensitivity: 0.3 volts RMS per inch at 1 kc. Frequency response: ± 1 db 1 cps to 200 kc; ± 3 db 1 cps to 400 kc. Input impedance: 4.9 megohms at 1 kc. Sweep generator: Range—10 cps/500 kc in five steps, variable, plus any 2 switch-selected preset sweep frequencies in this range. Synchronizing: automatic lock-in circuit using self-limiting synchronizing cathode follower. Power requirements: 105-125 volts 50/60 cycles AC at 80 watts; fused. Dimensions: $14\frac{1}{4}$ " H x $8\frac{1}{2}$ " W x $16\frac{1}{2}$ " D.



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*A. C. Nielsen estimate of U.S.A. homes with TV, September, 1963

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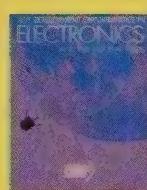
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TELEVISING THE MOON

... *What Are the Requirements of Future Lunar Landings?* ...

On July 31, after 6 previous Ranger attempts to reach and televise the moon had failed, the RCA-designed television cameras of Ranger 7 sent to earth the first closeup televised pictures of the moon's surface. This historical feat was accomplished by the Jet Propulsion Laboratory of the National Aeronautics & Space Administration (NASA).

The unmanned Ranger 7 had traveled through 240,000 miles of space to hit the target, the moon, 2,160 miles in diameter, in a voyage that lasted 68 hours. Starting at about 1,200 miles from the moon, and for the last 17 minutes of their flight, the six high-resolution cameras took 4,316 still pictures with a 1,152-line scan. First two wide-angle cameras started operating. Four narrow-angle cameras, scanning a smaller area, began operating.

The vidicon signals then were converted to FM signals to earth by 260-watt transmitters at frequencies of 959.52 and 960.58 mc.

The signals were picked up on earth by two 85-foot Goldstone antennas, 150 miles northeast of Pasadena, Calif. They were recorded in two ways: optically and magnetically on tape.

The 382-pound television system was designed primarily to give a series of closeup views of the moon's topography to help find a suitable site for future manned lunar explorations.

During the last few seconds of Ranger 7's flight, when it was approximately 1,000 feet from the moon, the last television picture—or rather, an incomplete picture—was taken. This then was the closest picture obtained. All it showed were some small craters down to sizes of three feet. In the words of Dr. Gerard Peter Kuiper, of the University of Arizona, who headed the Ranger 7 team of the Jet Propulsion Laboratory, "the best resolution (of the picture) obtained is approximately one foot and a half."

To the nonastronomer and the nonlunar scientist, the television pictures, excellent as they were, and 1,000 times clearer than anything man ever had up to now, seem puzzling at first. It should always be remembered that the closest picture of the moon's surface taken by Ranger 7 is still 1,000 feet up. And how much detail can one see of the 5th Avenue pavement from the 80th floor of the Empire State Building? Very little. Not only that, but at such a height there is very little perspective of the street.

While all NASA scientists are highly elated over the Ranger 7 results, it will be many months before the 4,000-odd photographs are finally deciphered and evaluated.

So far it seems that one of the most important lunar puzzles has already been partly solved—the deep dust problem. According to NASA astronomers, the dust layer probably is only 2 inches to 12 inches deep—not deep enough to prevent a successful manned landing. Nor are the small pits, the little craters, dangerous enough to prove disastrous.

Previously, Dr. Kuiper said it had been speculated there might be a thick, potentially dangerous layer of dust on the surface. But the evidence of the latest pictures "requires us to assume that the surface is hard."

"I am willing to bet that if you walked on the moon it would be like crunchy snow," he observed at a briefing conducted for Congressmen in Washington on Aug. 6.

It is now certain that there will be many other Ranger-like unmanned moon shots before manned exploration expeditions are attempted.

Nor will we have further crash landings, unless they are wholly accidental. Today lunar technology has advanced sufficiently to soft-land our capsules without shock and consequent damage to their dozens of vital exploration sensors.

Such future capsules will have a variety of television cameras for closeups of the immediate lunar vicinity, as well as photographs of the earth from the moon. All sorts of temperature measurements will be taken, not only of the moon's surface but several feet below, during regular intervals. The results will be radioed every hour to earth scientists.

There will be regular seismic tests exploring the moon for expected earthquakes, due chiefly to disturbances induced by the tidal effects of the earth's gravitational pull. All these effects will be radioed to earth.

The true composition of the moon's crust will be analyzed by chemical-physical robots and reported at intervals to earth monitors.

What are the electrical effects on the moon's surface of the wide fluctuation of its temperature, from plus 200°F to minus 250°F? Our future Rangers will supply the answer. We should always remember that the moon, having no atmosphere, is in a perfect vacuum, hence the wide temperature fluctuations may give rise to cathode-ray currents near the surface, which might prove annoying to explorers.

How often do micrometeorites strike a given square yard on the airless moon? So far we do not know. But our robot-equipped lunar capsule will radio the answer to earth to the satisfaction of our scientists and our later lunar explorers.

What about the effect of solar winds on the unprotected moon's surface? We are now in the quietest part of the solar cycle. What will be the effect on the moon when we go into the high-activity part of the sunspot cycle 3 or 4 years hence? As yet we do not know if such a period is dangerous to lunar explorers. But our moon-capsule robot will give us the answer, before we get there.

Let us never forget that the physics of the moon environment and those of the earth differ vastly. We cannot take chances with live men on the moon until we know for certain.

Finally, before too long we will probably change our ideas on how to *soft-land* our sophisticated Rangerlike robots. One idea is shown here. Instead of using compression

continued on page 78

Radio-Electronics Reports on

AMPLIFIED INDOOR ANTENNAS FOR FM AND TV

By PETER E. SUTHEIM
ASSOCIATE EDITOR

ONE THING THAT HAS BUGGED PEOPLE since radio's earliest days is the need for cumbersome antennas. To solve the problem, man has spent about as much time as the ancients spent trying to transmute lead into gold. And (with a few notable exceptions), he has had about as much success.

The loop antenna and its more recent little brother, the ferrite-core coil antenna, have helped make medium-frequency AM reception much more convenient with no sacrifice in quality. It was logical to try the same for FM and TV, at vhf.

One serious difficulty came up immediately: though the short wavelength makes resonant antennas practical, the smaller physical area of the active antenna doesn't intercept enough radiated rf energy to feed a large enough voltage to the receiver. In addition to the simple dipole, directors and reflectors are necessary.

But usually you can't bring even a small vhf parasitic array into your living room. So, most people who can't put up roof or attic or window antennas are stuck with one or another version of the dipole: the familiar "rabbit-ears" or one made of 300-ohm ribbon lead.

Indoor antennas of that kind suffer, not only from being too simple for good weak-signal reception, but also from being indoors—often inside a steel-frame building.

In a bid to solve this nuisance, amplified antennas have recently hit the market. All so far depend on some relatively simple antenna, coupled to an integral transistor amplifier whose output goes to the terminals of the TV or FM set.

The first of these (not being made any longer) was Gallo's *FMS-101* (Gallo Electronics Corp., 12 Potter Ave., New Rochelle, N.Y.), an FM antenna which appeared early in 1962. The claim made for it was exciting: it could eliminate the need for outdoor antennas

altogether in some locations. Technical people were skeptical, and those who tried it—as did we at RADIO-ELECTRONICS—found good reason. We tried several, just to make sure we weren't judging a lemon but, in each case, performance with a top-quality FM tuner in a strong-signal receiving location a few miles away from the station was no better than from a pair of rabbit-ears.

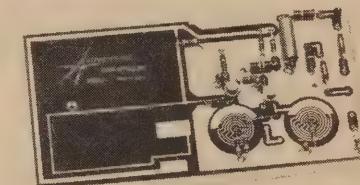
No question about it—there was gain, and plenty of it, as we could prove by pulling the ac plug while the tuner was on a station. But the transistor's gain was just about great enough to raise the overall output to about that from a dipole at the same spot.

Multitron "FM Stereo"

In the middle of 1963 the Multitron, *FM Stereo* made by Multitron Corp., 309 Queen Ann Rd., Teaneck, N.J., came out. It features a two-transistor amplifier. Fig. 1 shows the circuit.

The unit tested had higher gain than the original Gallo, but the improvement was masked by a corresponding increase in noise. Though the signal-strength meter on the test tuner (a Fisher KM-60) read higher with the Multitron antenna than with the reference rabbit-ears, signal-to-noise ratio did not improve, and sometimes dropped audibly. This was particularly apparent on stereo stations. On strong signals, the Multitron worked as well as the rabbit-ears, but on weak signals it introduced enough noise to ruin reception.

The antenna in the Multitron is unusual. Strips of copper foil (part of the printed-circuit board) run in a way that



Top and interior views of the Multitron FM Stereo antenna. Antenna elements are the printed-circuit loops at the left in the interior photo.

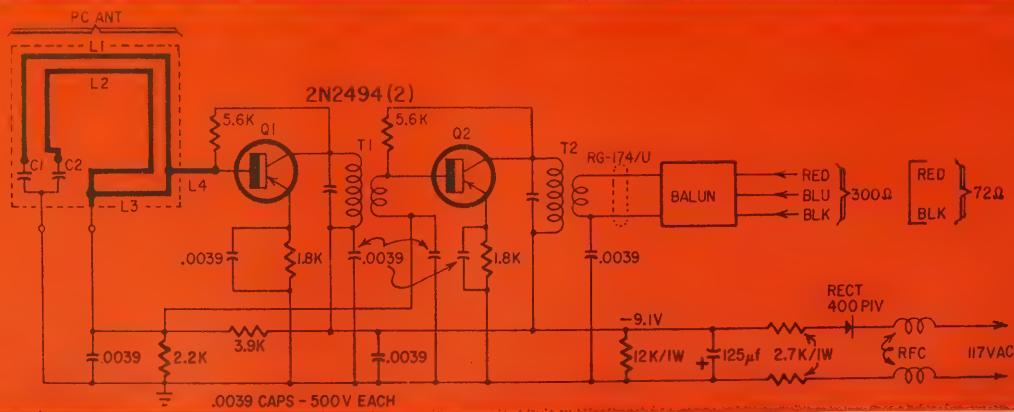
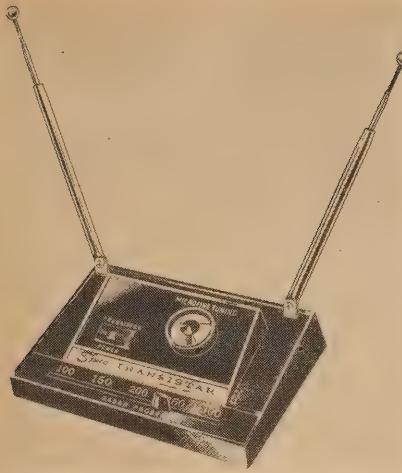


Fig. 1—Schematic of the Multitron FM Stereo amplified FM antenna.



The Spico Transistar amplified antenna is tuned by a shorting bar and trimmer capacitor.

is hard to describe—better look at the photo and Fig. 1. A double-sided board is used, and the rectangles you can see in the photo lie just over large areas of grounded foil on the other side, making up capacitors (C1 and C2 in the schematic, Fig. 1). These two separate systems, with the inductance of the foil paths, spread the antenna over the 88-108-mc band. L1-C1 tunes to 88 mc, L2-L3-C2 tunes to 108 mc and L3-L4-C3 tunes to 100 mc. (C3, not shown, is the base-emitter capacitance of Q1.) There is no input transformer; the low impedance of the series-resonant pickup network matches the input impedance of the transistor. Both transistors are 2N2494's.

Coupling between Q1 and Q2, and between Q2 and the output line, is though printed-circuit transformers, visible in the photo as spirals. Output goes to the tuner through single-conductor coax cable. There is a matching transformer (balun) at the far end of the cable so the system can work into unbalanced 75-ohm or balanced 300-ohm inputs, depending on which lugs are used to connect to the tuner.

The power supply has chokes in each leg of the line to keep line noise from interfering with the signal and to reduce regeneration through the line cord.

Channel Master "FM Stereo"

This antenna, *FM Stereo* model 3731, is a dipole (rabbit-ears)-plus-amplifier system. It works well, certainly as well as indoor dipoles at low- and mid-band and, happily, better at the high end.

Because of the external telescoping elements, this antenna has a better chance to pull in a useful signal than the earlier self-contained systems like the Gallo and Multitron. The difference is apparent. But, like the others, this one's

amplifier also adds noise as well as gain, and this noise is sometimes enough to mask any benefits from the extra boost. What this antenna can do, that others cannot, is to bring in some weak signals you may not have listened to before, and clean up a few marginal ones. But not all.

The Channel Master *FM Stereo* has a tendency to oscillate unpredictably in certain positions and at certain settings of its switch and the tuner dial. Channel Master is slipping a little note in with each of the antennas, warning the user of this possibility and urging him to keep the output lead well away from the ac line cord. This turned out to be necessary in the unit I tested.

The antenna produced several spurious responses at extreme ends of the FM band. I normally pick up the audio from Channel 6 at the low end of the dial, but in this case that was almost drowned out by a "freak" from a local station at 92.3 mc. A station at 105.1 mc also appeared near there. Possibly a case of signal overload and cross-modulation in the antenna system, a common fault of transistor rf amplifiers at high signal inputs. It happened with two different FM tuners, even with a 20-db pad in series with the antenna lead. Something to watch for in strong-signal areas.

In all, this one seemed to be definitely superior to ordinary rabbit-ears, but wouldn't replace an outdoor or attic antenna.

The circuit (Fig. 2) is very simple. Input and output are matched to the inherently unbalanced transistor amplifier via baluns. The inductances are made broadly self-resonant along the FM band. The output lead is 300-ohm ribbon, unshielded, which may help to account for the tendency to become unstable. The output lead and the dipole elements are prevented from becoming shock hazards by high-voltage 56-pf ceramic capacitors in each leg. Signal

ground is further isolated from the ac line by a 4,700-ohm resistor.

Spico Transistar

This antenna (made by Spirling Products Co., Henrietta St. near Duffy, Hicksville, N.Y.) is for FM and TV, and there'll be more about it further along in the article. Tested under the same conditions as the other antennas, the Transistar performed almost as well as the Channel Master *FM Stereo*, and better than the units without "ears." It wasn't as "hot" as the Channel Master but was less prone to oscillate. The sliding and rotary tuning elements seem to have been a design engineering feature. At no point did they improve anything, although they could make weak stations disappear into noise at some points. The circuitry is about as straightforward as possible. The transistor is neutralized, which probably contributes to the unit's stability.

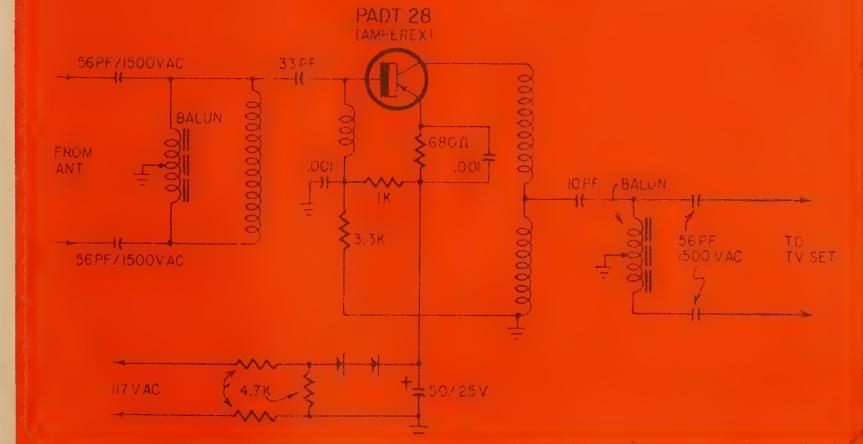
Next I tried the same antennas on an inexpensive "non-hi-fi" table FM set, and results were similar, though slightly better. The low noise figure of top-quality FM tuners is likely to be exceeded by these transistor amplifiers, so that there is no apparent improvement. More modest sets benefit more.

TV performance

Two antennas in the group covered in this article are designed for TV reception. The Spico Transistar covers FM and TV, and the Channel Master *Apollo* is designed for TV. The *Apollo*'s circuit is similar to the *FM Stereo*. Additional tuned circuits are used for broadband performance. It's antenna switching circuit is in Fig. 3.

I conducted two sets of tests. One took place in Bayside, N.Y., about 15 miles from the Empire State Building, where New York City's TV transmitting towers are located. The location was chosen as typical of suburban situations. The second set was in Danbury,

Fig. 2—Channel Master's model 3731 FM Stereo antenna. Single transistor provides gain.





Channel Master FM Stereo

Conn., 50 air miles from New York City, 25 air miles from New Haven (Conn.) and 45 air miles from Hartford (Conn.)—a good example of "middle-fringe" conditions.

The Bayside tests were done with a good-quality TV set about 10 years old, with a straight pentode rf stage, not especially peaked or aligned for the tests. The *Transistar* and the *Apollo* were compared with each other and with a rooftop conical antenna about 35 feet off the ground, aimed at the Empire State Building. The set, with the rooftop antenna, normally gave clean pictures on channels 2, 4, 5, 7 and 9, and unpleasantly snowy ones on 11 and 13.

The apartment was near the ground in a steel-and-brick building, so I expected poor reception from the indoor antennas. The situation is that of tens of thousands of city residents, so is pretty much representative.

The *Transistar* gave only slightly poorer performance than the outdoor antenna on channels 2-9, and definitely superior performance on 11 and 13. In some cases, a channel came in equally well from both antennas, but the *Transistar* had to be turned or held in such a way as to make it impractical for normal use. In no case did the slide-wire tuning device ("Radar Probe") give any improvement; on the higher channels the picture blanked out near the left end of the slider's travel. Likewise, the "Microfine Tuning" knob had no discernible effect.

The *Apollo* was excellent on all channels. It showed a slight tendency to oscillate when the lead-in and ac line cord were near and parallel. The selector switch positions seemed to make no sense: the picture might be excellent in two adjacent positions, impossibly snowy on the next, and fair on the one

after. On each channel, several switch positions gave about equally good reception.

I chose the Danbury location to see just what these antennas could really do. There I compared them with a multi-element Yagi in the attic of the house. The house was on a hill, more or less in the clear in the direction of New York City. The set was a recent model.

All New York channels except 13 came in acceptably (only channel 9 was a bit snowy). There was a good

The *Apollo* did not give as good an account of itself. On channel 2 it was fair, on 3 better than the attic or Transistor antennas. On 4 it was very poor and oscillated at switch positions C and F. Channel 5 was fair, with oscillation at G. Channel 7 had considerable snow and the amplifier was highly unstable in switch positions A, D, E, G and K—and so on.

This poor performance was surprising compared with the good showing in New York City. I concluded that

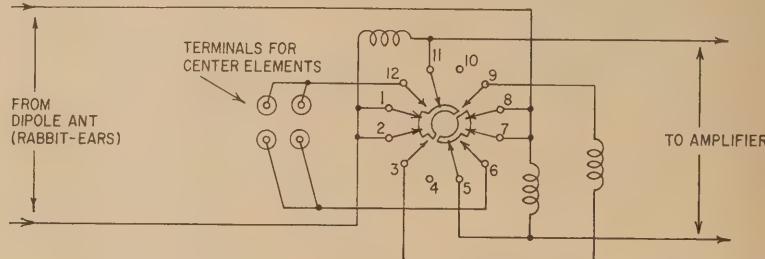


Fig. 3—Antenna tuning circuit in the Channel Master Apollo. A similar arrangement is used in the FM Stereo.

signal from channel 8 in New Haven, though it was slightly off the antenna's pattern. Channel 3, Hartford, was un-receivable, being "off the back of the beam."

With the *Transistar*, performance on 2 and 4 was not nearly as good as with the attic antenna. Channel 3 was much better than before, because the antenna, unlike the attic array, could be oriented to favor it. Channels 5, 7, 8 and 9 came in about even. Channel 11 came in somewhat better with the Spico, and channel 13 was now visible.

So, just as within the city limits, reception improved most on the highest channels. Again, neither of the controls had any positive effect. On channel 5, lead-in position was critical, and the antenna tended to break into oscillation at the full-open setting of the knob.

The Apollo, by Channel Master, is for TV reception.



the set connected to the antennas makes a difference; the *Transistar*, too, showed signs of instability on this TV set but not on the one in Bayside. If you intend to buy or recommend one of these or any other amplified antennas, it might be wise to check before you seal the transaction. Some sets are touchier than others; this turned out to be true of FM tuners, too.

My harshest criticism of the *Transistor* is of the mechanical construction. The treatment I gave it during the tests, about equivalent to a week or two of normal use, was enough to loosen the tuning knob and begin to strip the threads of the trimmer capacitor screw. The slide-wire tuning device began to bind slightly. The *Apollo* is much sturdier, and the lettered switch positions make it easy to note the best settings for a particular channel.

The *Transistar*, effective as a TV antenna, did well too on FM. It was less beset by spurious responses than the Aurora.

Conclusions

Amplified indoor antennas fill a gap in the antenna market, and can help solve the problem of those who can't put up multi-element outdoor or attic antennas, yet need better reception than simple dipole antennas can give. They are no sweeping solutions to the antenna problem, as some have suggested. Systems that combine rabbit-ear dipoles with amplifiers are definitely superior to those that depend on amplifiers alone. Low-gain TV or FM sets, or ones with noisy front ends, will usually show more improvement than recent "hot" designs.

END



UNIVERSAL TAPE-PLAY PREAMP

Noise down 65 db below average recording level! Matches any playback head!

Substitutes directly for the tube preamp in your recorder!

By REGINALD WILLIAMSON

THIS THREE-TRANSISTOR PREAMP, installed in your recorder or player, will give you less noise with less heat and longer life than the tube preamp stages it replaces. It works with any kind of tape playback head, regardless of inductance—a really universal preamp!

Only selected tubes with dc-supplied heaters could approach the low-noise, high-gain amplification this preamp offers. Yet transistor tape-head preamps have been a little slow in becoming popular. Why?

The basic difficulty is that the conventional tape playback head is a voltage generator with a substantially inductive source impedance. A typical head designed for a tube input stage, for example, may have a source impedance as high as 100,000 ohms at 15 kc. Transistors are current-amplifying devices with input impedances of a few thousand ohms at most. So we have a matching problem. If we treated our typical playback head as a voltage generator and fed it into a conventional common-emitter input stage, at the frequency where the source impedance of the head

equaled the input impedance of the transistor stage, the response would be down 3 db, and from there would fall at 6 db per octave. An orthodox common-emitter stage has an input impedance around 5,000 ohms and a typical playback head may have, say, 1 henry inductance. Some elegant circuitry is going to be needed to bring together these two seemingly incompatible devices.

The first solution adopted by designers was the obvious one—to produce tape playback heads of substantially lower inductances. But this answer will be cold comfort to the owner of a tape recorder with the older high-impedance heads. This article is for him.

The circuit

The circuit (Fig. 1) consists of three transistor stages, direct-coupled throughout. The power requirements are approximately 2.5 ma at 9 volts and, since the circuit is required to be compatible with existing tube circuitry, it was designed so that the power can be derived from any negative-grounded supply already available. The first stage is a common-emitter run at low collector current (200 μ a) to minimize the noise. Base bias for this stage is obtained from the emitter of the second stage, also a common-emitter, via R2 and R6 in series. Since the two stages are direct coupled, collector to base, and have high dc negative feedback, the combination is fully stabilized against temperature changes

and variations in individual transistor characteristics.

Any signal across the emitter resistors of the first and second stages, plus any signal in the power supply, is bypassed to ground by the two 100- μ f capacitors. The base bias network is included in the main negative feedback loop to eliminate the shunting effect of R2 and R6 across the input.

The output stage is common-collector, designed for low output impedance and so, it is indifferent to the varying load presented by the main feedback network.

This feedback network is connected between the emitters of the first and last stages and the playback curve can be adjusted by varying the 10,000-ohm preset resistor. If more than one curve is required, separate switching can be arranged to select individually adjusted preset resistors. The 100,000-ohm resistor across the .03- μ f capacitor provides for the fall in playback response below 100 cycles in conformity with the NARTB standards for 7½ and 15 ips. European readers who wish to use CCIR standards instead can omit this resistor.

Constructional details

A printed circuit is nice but by no means essential; if there is sufficient interest, the writer can arrange for a limited supply of ready-etched boards, es-

C1—1 μ f, 6 volts, miniature tantalum electrolytic

C2—1 μ f, 3 volts, miniature electrolytic

C3, C4—100 μ f, 12 volts, miniature electrolytic

C5—0.25 μ f, miniature paper or ceramic

C6—.03 μ f, miniature paper or ceramic

Q1, Q2, Q3—2N412 (RCA). A likely alternate is the more recent RCA 2N2613, with similar characteristics, designed especially for low-noise preamp service and being used for that by several hi-fi component manufacturers.

R1—3.3 megohms

R2, R11—100,000 ohms*

R3—470 ohms*

R4—33,000 ohms*

R5—2,200 ohms

R6, R8—10,000 ohms*

R7, R9—2,700 ohms*

R10—330 ohms

R12—pot, 10,000 ohms, linear

Resistors marked (*) are 1/2-watt low-noise, high stability types (deposited carbon or metal film). 5% accuracy is sufficient, but most such resistors are available in US only in 1% tolerance. Other resistors can be 1/2-watt 10% carbon-composition type.

Printed-circuit board, single-side copper foil, 3 1/4 x 3 3/4 inches

Terminal and mounting hardware

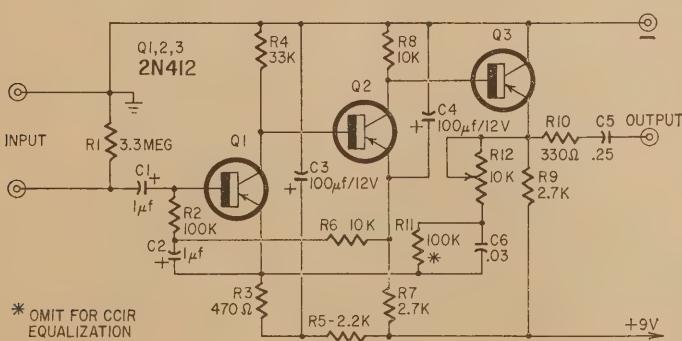


Fig. 1—Circuit of the Universal Tape-Play Preamp. Negative side of supply is grounded, so unit connects easily to voltage divider from existing power supply in tape recorder. But battery operation is practical—circuit draws only 2.5 ma from 9-volt battery.

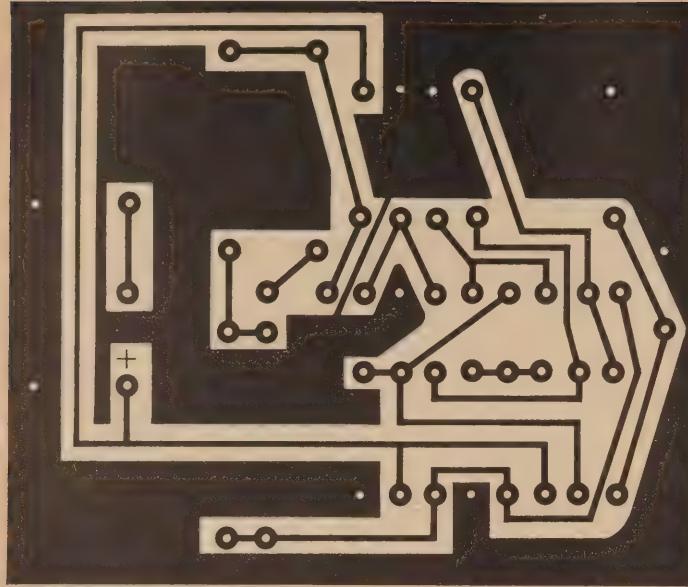


Fig. 2—Actual-size etch pattern of circuit board for preamp. Hand-wired version is perfectly all right, if you prefer.

pecially for English readers. However, the layout is simple and can easily be drawn direct on copper laminate with resist ink and then etched (Fig. 2). Fig. 3 shows the layout of parts.

The signal-to-noise ratio of the preamp depends almost entirely on the choice of Q1. The RCA 2N412 is an inexpensive rf type that has proven ideal in a number of prototype units. Substituting a special low-noise transistor gave only a marginal improvement. The constructor who wishes to try other types is at liberty to do so, of course. No schematic changes should be necessary, provided the transistors used are high- h_{fe} (alternating current gain) p-n-p types with a f_{hrf} of not less than 8 mc. Lower values of f_{hrf} can give rise to cumulative phase shift within the feedback loop and perhaps instability.

A prototype preamplifier has been tested with heads of various inductance, from 5 mh to 5 h. The higher-inductance heads naturally gave the highest output from the preamplifier. There was some variation of signal-to-noise ratio with head inductance, although it was never worse than -52 db (unweighted) referred to a 1/2-track 3% recorded signal of 440 cycles. The highest ratio came with head inductances from 70 to 150 mh. When the test signal was passed through a standard weighting network,

which gives a more accurate assessment of the subjective effect of noise, the total noise level was never worse than -65 db. In both cases, the noise from virgin tape was much greater, so one could not wish for better performance.

Connection and calibration

The 9-volt supply can be derived from almost any convenient point in a tape recorder with conventional B-plus power supplies. If taken from the main B-plus line, it is wise to use a voltage

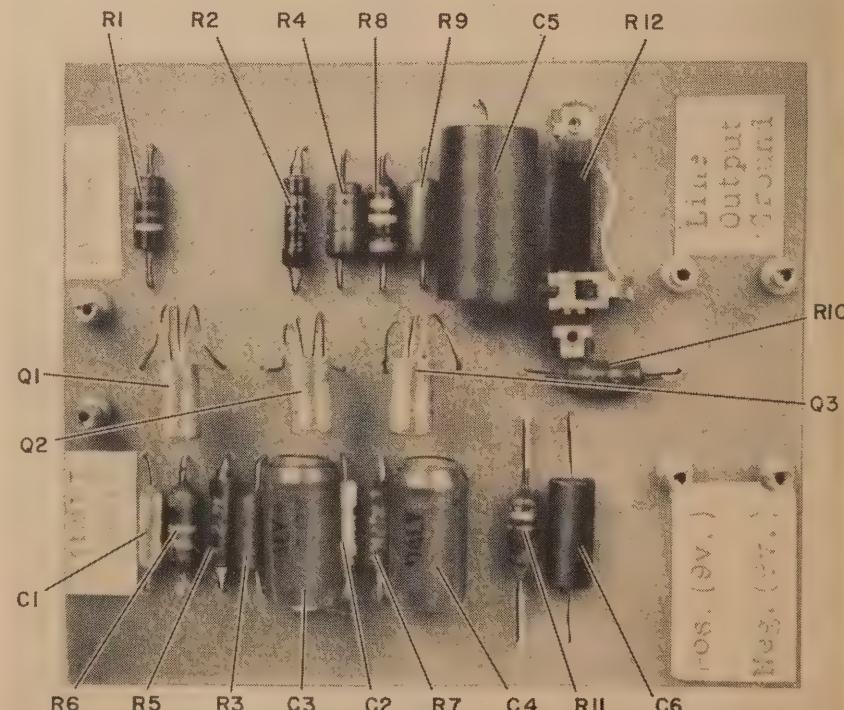
divider to tap off the 9 volts. The divider should take some three to four times the current drain of the preamplifier. Fig. 4 shows some suggested arrangements from a 250- and a 350-volt B-plus line. An alternative, slightly more expensive method using a Zener diode is preferable where the high current drain cannot be tolerated.

When the playback head has been connected to the preamplifier and all soldering completed, the head must be demagnetized. Thereafter, protection against accidental magnetization is built into the preamplifier.

POINTS ALONG THE NARTB TAPE PLAYBACK CURVE			
20 kc	-10 db	1 kc	0
15	-10	500 cycles	6
10	-10	200	14
5	-8.5	100	18.5
3.2	-7	30	22

Acceptable tolerance is usually ± 2 db

The main calibration is carried out with a standard tone tape, recorded to the appropriate record curve. The only adjustment necessary with modern microgap heads is to the 10,000-ohm resistor; it should be possible to adjust the response to within 2 db over the test range. If it is difficult to equalize to this accuracy, the electrical response can be



Top view of board shows location of each part.

BENCH



TESTED

RADIO-ELECTRONICS sent Mr. Williamson's preamp to another professional audio man, who tried it for several days and made a few measurements. He found it worked every bit as well as the author claims. "Equalization was accurate to within 1.5 db everywhere except at the extreme low-frequency end, where response dropped off to -2 db [an inaudible difference]." Noise was also inaudible. The unit proved easy to connect and there were no apparent "bugs".

Make Your Own Service Manuals

EVEN ELECTRONIC EQUIPMENT YOU build yourself occasionally requires maintenance. The typical troubleshooting procedure usually sounds like this: "Now let's see, where is that schematic? Did that pin have 6 or 10 volts on it? Where did I buy this special coil?" Sound familiar? If it does, assembling a "servicing manual" for each piece of equipment may be the answer.

Professional repairmen rely on the manufacturer's service folder or the popular Photofacts. Unfortunately, home builders usually have only one article for their entire information source. Even well written articles do not have the space to include *all* the necessary information about construction hints, special alignment tricks, debugging, voltage checks and critical waveforms. And you may run into a special situation the author never even thought of.

While you build the unit, write down the part numbers of any special components and where to buy them. Parts that have been modified for the circuit should be noted. After construction, draw a sketch of the major component locations and include identifying names or numbers. If the device passes the smoke test, record any special testing and debugging techniques.

After you have tested the unit and are sure it is working properly, record normal resistance, voltage, current and waveforms at each circuit junction and tube or transistor pin. Note such things as typical hum levels, gain, noise, etc. If you wish, redraw the schematic (especially if you've changed the original unit) and label each part with any special information — wattage, temperature coefficient, size.

Besides saving the original article, record on a separate sheet the title, author, date and magazine in which the article appeared. That way, losing the article will not hamper future servicing — just go to the library and look it up.

Changes or corrections for a previously published article are generally printed in the "Letters to the Editor" column. Corrections are noted on the contents page under The Departments. Clip them out and add them to your file. Note also if you made the suggested changes. Any changes you make in the original article should be carefully noted; modifications and their reasons have a way of becoming obscure with time.

If you should require the aid of a technician, bring your servicing manual along. Remember, he has no Photofact for your special project! —Robert K. Re

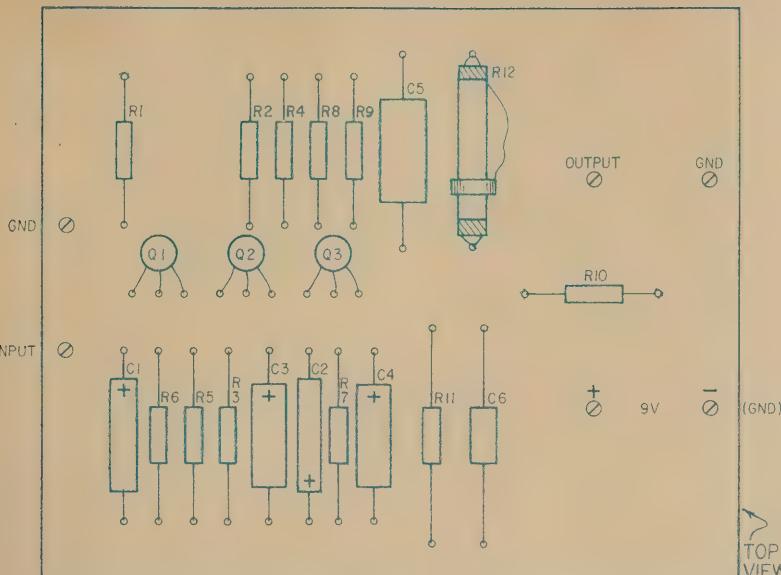


Fig. 3—How parts go on the board. Layout is approximate only and will vary slightly depending on exact component sizes.

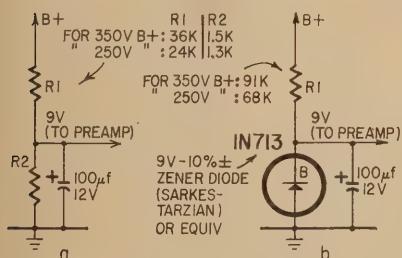


Fig. 4-a—Simple voltage divider off well-filtered B-plus line supplies power to preamp. (b) is Zener-regulated supply, recommended for twin preamps for stereo.

While a modest rise is permissible and may help to offset the physical losses in the head, such as gap effect, it should not exceed 2 or 3 db at 15 kc.

If the lead capacitance cannot be reduced by shortening the lead, it may be necessary to lower the input resistance and thus damp the resonance. A temporary variable resistor connected across the input together with the head leads should be adjusted until satisfactory. The nearest fixed value can then be substituted for the 3.3-megohm resistor shown. This should be regarded only as a last resort and will result in some reduction in high-frequency response above resonance.

END

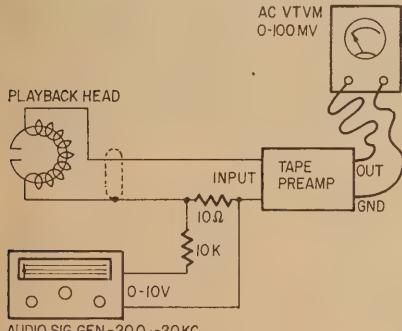


Fig. 5—Test setup for checking equalization.

checked, using the setup shown in Fig. 5. It should be within 2 db.

With the preamplifier calibrated for the NARTB standard for 7½ and 15 ips, the readings given in the table should be obtained to within ± 2 db. If the measurements prove unsatisfactory, then the head is probably at fault and may have to be changed. With heads of more than 200-mh inductance, lead capacitance may cause resonance within the audio band. That shows as an increase in response above, say, 5 kc.



"Gassy, isn't it?"

"MOCKUP" SPEEDS COLOR SERVICE



The author turned a trade-in color set into a useful bench aid

By HOMER L. DAVIDSON

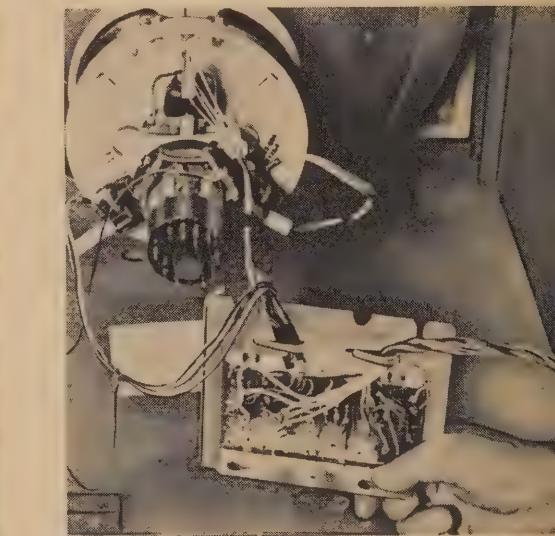


Photo 2—A better look at the convergence board of the stripped set.

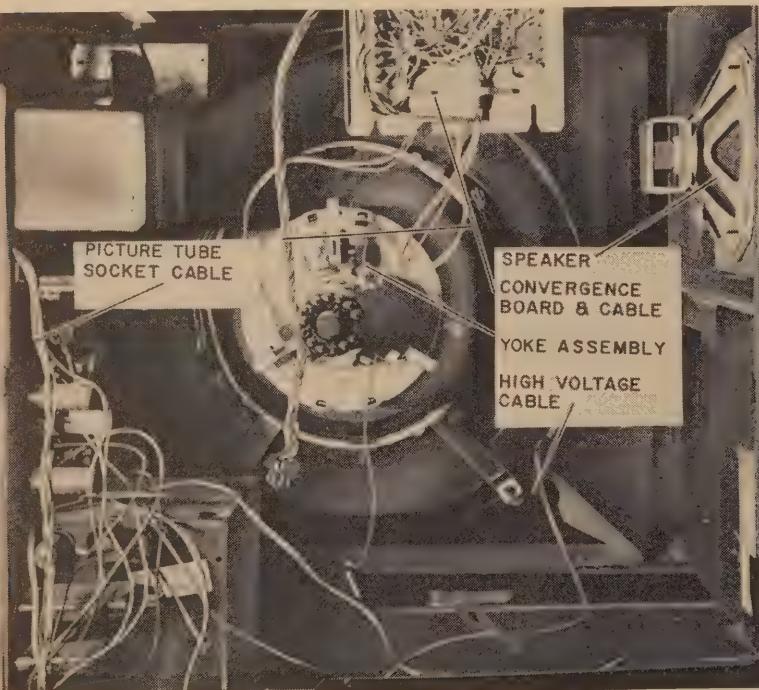


Photo 1—The parts of the original color set you will retain for the mockup.

COMMERCIAL COLOR MOCKUP TEST units are expensive, but if you plan to get into color TV servicing, you'll need one. With it, you can eliminate one man on a color TV service call, if the set must come into the shop for repair. Just pull the chassis and bring it to the shop. Also, it's more convenient to hook the color chassis to a test unit right on the bench than to try to work behind it.

It is very easy to construct your own color mockup tube out of a regular color receiver. We had taken a 21-inch table-model color receiver in trade on a

console color set. The color picture tube was in good condition. We allowed \$125 for the trade, and the receiver was only 3 years old. By adding a few home-made cables, we have a pretty cheap color mockup. This works only for RCA CTC 9's and later models.

First remove the color chassis from the set you plan to use. Do not disturb the picture tube, yoke and convergence assembly. Leave the speaker in the cabinet if you don't have a speaker test unit on the mockup bench. Clean the cabinet thoroughly. Photo 1 shows the units

that will be in the mockup. Photo 2 shows the "stripped" cabinet, with only the CRT and convergence board left. Now you need connections to the yoke assembly, picture-tube socket, high voltage, convergence control board and speaker, and a good ground cable.

Cable construction

Five wires connect from chassis to yoke assembly. The vertical connections are yellow-black and yellow. The horizontal winding connections are red, blue and blue-black. Most color receivers

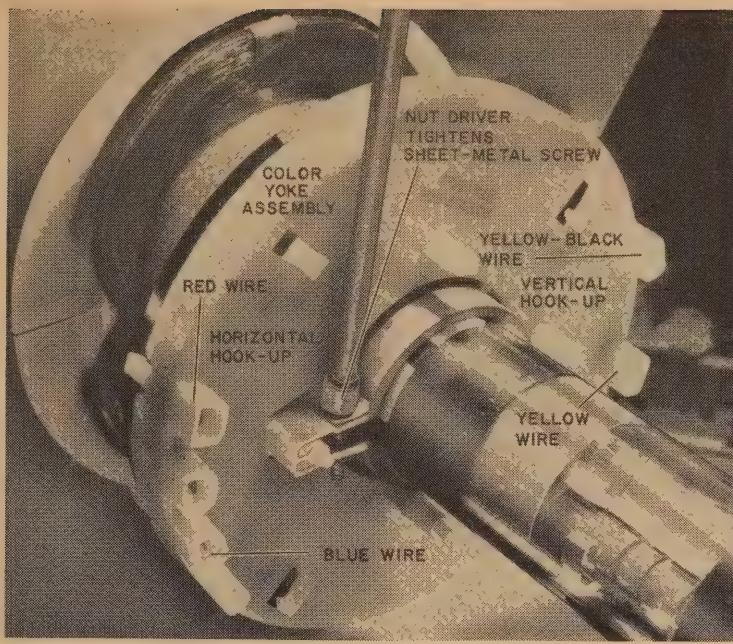


Photo 3—Yoke connections and assembly.

use only the red and blue wire connections.

Select a good grade of flexible hook-up wire or test lead. Make all cables 4 or 5 feet long. Remove the plug-in lugs and yoke wires from the color chassis and solder them to one end of the extension cables. Make a spade lug for each wire out of brass or copper pieces. Solder the lugs to the other ends of the extension wires.

These five wires should be color-coded as they were in the color TV receiver. If the correct insulation colors are not readily available, use paint. Brush or spray the correct color for about a foot from each end. Photo 3 shows the yoke assembly.

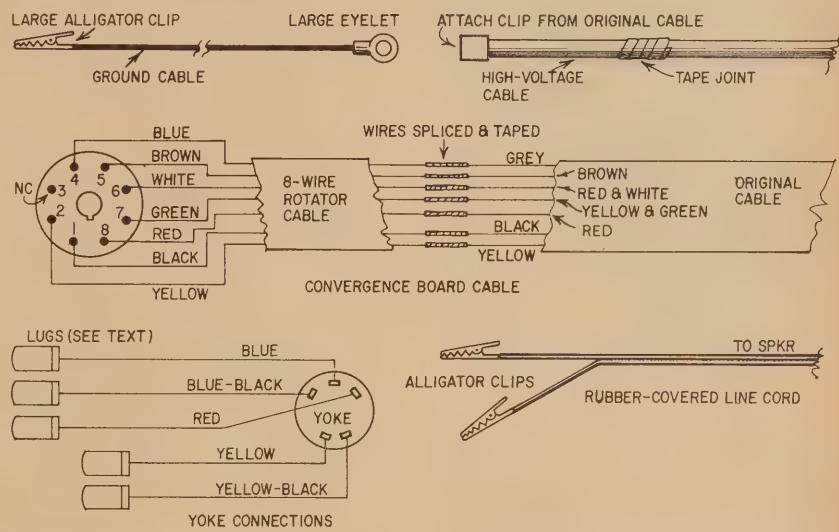
The 14-lead cable for the picture tube can be made but it is much cheaper to buy one. An Eby model 5-61214 serves very nicely. Make a high-voltage lead from a roll of 25,000-volt Belden cable No. 8868-25. Remove the clip from the present high-voltage cable and attach it to the end of the cable extension. A small alligator clip will also work on the high-voltage cable end. Where the two cables are connected together, use good plastic tape over the soldered joint, and saturate with corona dope or spray.

The convergence control board has an 8-prong tube socket that plugs into the TV chassis. Only seven wires are used, but an 8-wire rotator cable serves as a connecting cable. Connect as shown in the cable diagram. Remove the male tube socket from the convergence board, and solder each connecting wire to the rotator cable. Solder the other ends to the wires that were removed from the octal plug, and tape the joints.

Regular rubber-covered line cord



Photo 4—Extension cables protrude from control holes in mockup set. Bushings and dial plates from junkbox keep insulation from chafing on edges of holes. Plastic peg nearest hand is convenient for holding cables when mockup is not used.



The five extension cables you will need. Your set's convergence cable may use different wire colors, so check the schematic of your model for connections between convergence board and plug.

can be used as the speaker cable. Solder two small alligator clips to the connecting ends. Use a black test lead as a ground cable. Solder a large metal eyelet to one end and a large alligator clip to the other. Secure the large eyelet under one of the picture-tube mounting bolts. Run a short length of bonding strip from this bolt connection to the TV chassis. A good ground is a must. Tape the five yoke wires together to form one cable, taping every foot or so.

The wires protrude through holes in the side of the cabinet, as shown in Photo 4.

Setup and use

Before you can use the color mockup, you will have to check purity and convergence, and possibly touch them up in the usual way. Get a good color chassis and hook the mockup to it with the cables.

Once the test unit has been converged, you degauss the color CRT only occasionally. With the mockup, you can check the black-and-white picture and the chroma section with the chassis out in the open where you can locate a defective part.

END

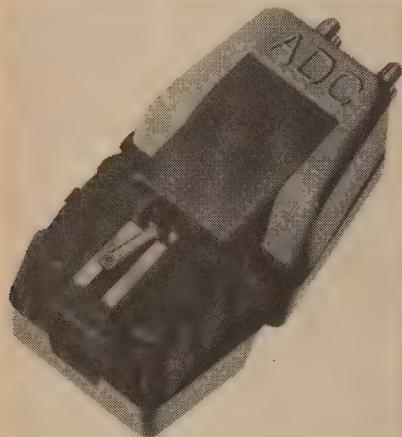
Modern Hi-Fi Stereo Cartridges

Roundup of a number of the leading types, with a few observations on pressure, tracking, stylus shape and other features in which high-grade cartridges differ

COVER STORY

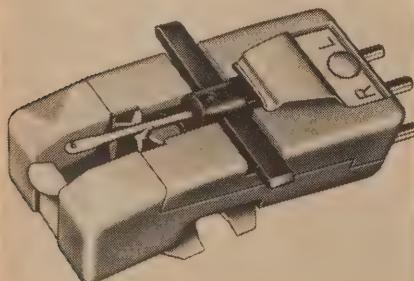
By ALBERT GRUNDY

ALL THE CARTRIDGES TESTED ARE AMONG the best available today; lack of time and space rather than selection account for any omissions. These tests are not exhaustive—as much weight has been given to actual music playback evaluation as to measurements. As the tests proceeded, three groupings evolved. During the tests, cartridges were shifted from one group to another, to achieve these final positions which appear in the box. Cartridges in Group I and Group II were almost indistinguishable, the main difference being in stylus pressure, though the frequency response in Group II has slightly wider tolerance.



ADC 770—magnetic

With the exception of the Ortofon SPU/T with its 0.5-mil spherical stylus, all pickups in the first group have elliptical styli. The elliptical stylus is not a panacea; it cannot correct inherent defects in any cartridge and often its contribution to superior reproduction can be negligible. The difference between two cartridges, one with a 0.5-mil spherical tip and the other with an elliptical stylus,



Astatic's "Cantata"—ceramic



Electro-Voice 150 "Featheride"—ceramic

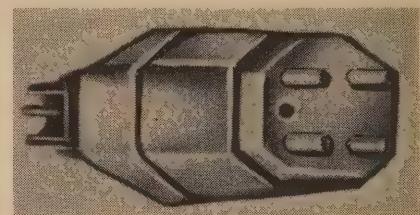
can be heard only near the inner diameters of records with high levels of modulation and often only on certain types of music. A very important factor to remember is that the rest of the system and especially the speakers, must be of comparable superior quality to realize the benefits of the elliptical stylus.

These Group I and II cartridges are to be used only with manual turntables and arms that provide for adjusting the stylus force down to $\frac{3}{4}$ gram. A height adjustment on the arm for proper cartridge leveling and a stylus overhang adjustment are also necessary. This overhang adjustment is often in the cartridge mounting shell of arms with plug-in heads.

Another feature common to all but the Ortofon, Empire and Weathers car-

tridges in Group I and II is that they operate at the industry standard of 15° vertical tracking angle. The Ortofon, Empire and Weathers cartridges are reasonably close to 15°.

The third group consists of cartridges for which the manufacturer has specified higher tracking forces. These are for automatic turntables and record changers. The group also includes those whose frequency response, separation or tracking ability did not fall within the specifications of the first two groups.



Empire 880p—magnetic

The first series of tests was made to determine the relationship between the tracking-force requirements of each cartridge and the manufacturer's recommended tracking force.

The tracking ability of these cartridges was first checked with the Ziff-Davis 211 test record. The low-fre-

CARTRIDGE GROUPING

GROUP I

Frequency response: ± 2 db, 15,000-40 cycles; separation 10-18 kc: not less than 10 db; tracking force: $\frac{3}{4}$ -2.5 grams
Audio Dynamics Point-4/E
Ortofon SPE/T
Ortofon SPU/T

Pickering V-15/AME-1
Shure V15

GROUP II

Frequency response: ± 3 db, 15,000-40 cycles; separation 10-18 kc: not less than 10 db; tracking force: 1-4 grams
Audio Dynamics 660
Pickering V-15/AM-1
Shure M44-7

Shure M44-5
Empire 880p
Weathers LDM

GROUP III

Frequency response: ± 6 db, 15,000-40 cycles; separation 8-12 kc: not less than 8 db; tracking force: 2-7 grams
Astatic Cantata
Audio Dynamics 770
Electro-Voice 149DF
Electro-Voice 150DF

Pickering V-15/AT-1
Pickering V-15/AC-1
Sonotone Mark IV
9 TAF HC SDV

ON OUR COVER: Modern high-quality phono cartridges are looking better every day. Our young lady is gazing fondly at (left to right) the Shure V15, Ortofon SPE/T, Electro-Voice 150-D, Sonotone Mark IV, Euphonics Mini-Mass and Pickering's V-15/AC-1.

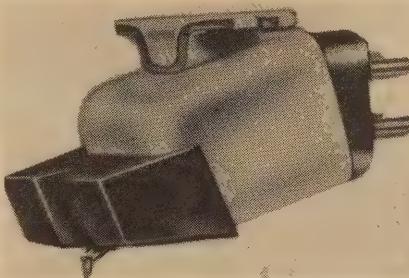
quency test consists of a 300-cycle tone recorded at a level easily tracked by any good pickup. The tone remains constant in frequency and swoops up in amplitude repeatedly to higher and higher levels. When the level at which the cartridge no longer tracks is reached, a distorted or buzzy sound is heard.

Each cartridge was set with the average force recommended by the manufacturer and each was checked to determine at what level this breakup occurred. Also, with the CBS STR 111 test record and by adjusting the stylus force downward, the minimum tracking force was determined. All the cartridges in Groups I and II passed the tests at the manufacturers' recommended average force, but only those in Group I would

walls. At low recorded levels, when the amplitude in the groove is small, it is relatively easy for cartridges to track at low stylus forces, if the compliance of the cartridge is adequate. At higher levels, more force is required to hold the stylus in contact with the grooves. With modern cartridges such as these, the

tones individually with no apparent distortion. Mistracking will cause the 500-cycle difference tone to increase in volume as each successive swoop is played. Since no cartridge tested could reproduce any more than the first band without distortion, evaluation was made on the basis of whether or not the level of the 500-cycle difference tone increased as the successively higher level bands were played. The judgments again are relative and the cartridges are grouped accordingly.

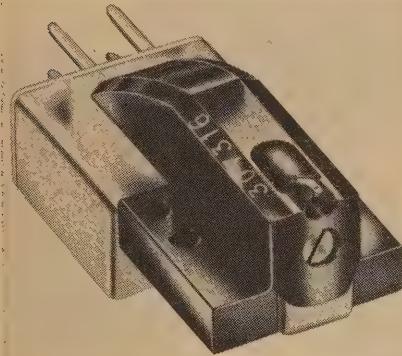
The frequency response was tested with both the CBS STR 100 and Ziff-Davis 211 test records. The first contains both sweep and spot frequencies and the second a series of 18 warble tones covering the spectrum from 20 to 20,000 cycles. The correlation between these tests was very good and the frequency response limits are shown with the groupings.



Pickering V-15—magnetic

compliance is high enough to track any normal low-frequency level with forces in the order of 1 to 3 grams. To track *forte* passages, especially those with heavy bass, such as organ or timpani, the stylus force must sometimes be increased to 3 to 5 grams.

The high-frequency tracking test on the 211 record has two tones, 11,000 and 11,500 cycles recorded simultaneously in a series of volume swoops like those in the low-frequency tone tests. Perfect tracking will reproduce these



Ortofon SPU/T—magnetic

pass when set near the minimum recommended stylus force.

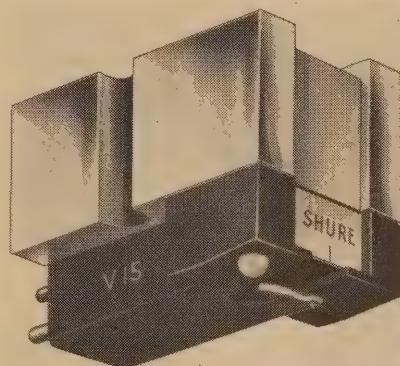
Proper cartridge tracking is a function of the ability of the stylus to maintain constant contact with the groove

Elliptical Stylus

The elliptical stylus is a departure from the spherical which has been universal for many years. The advantage of the elliptical tip is that its profile is more nearly like the chisel-shaped cutting stylus used to engrave the recording. Unlike a standard conical stylus, which has a rounded spherical point, the tip of the elliptical stylus is an elongated oval. The major axis of the ellipse is perpendicular to the groove walls; the minor radii contact the groove walls themselves. These small radii are able to trace the small sharp angles in the groove modulation that are produced by high frequencies and high-level cutting. This ability is approached by spherical stylus with very small tip radii, but there is always the danger of such a stylus bottoming in a groove with heavy vertical modulation. The elliptical-shaped stylus does not have this problem.

The result of this more intimate contact with the groove walls is a reduction of tracing distortion. This is most apparent at the inner diameters of the record when the groove length per revolution is very short.

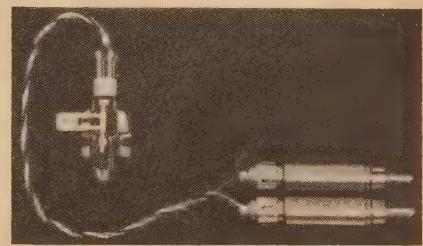
The idea of an elliptical stylus is not new. They have always been obtainable but extremely expensive. The methods of manufacturing diamond stylus have been improved considerably and the elliptical stylus can now be bought at approximately twice the cost of a standard stylus.



Shure V15—magnetic

Vertical Tracking Angle

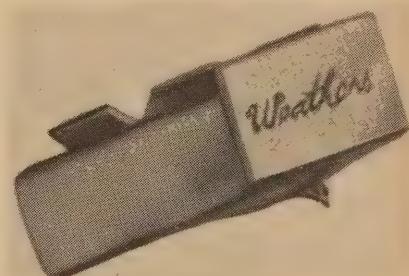
Vertical tracking angle is the angle between a line perpendicular to the surface of the record and the line along which the stylus moves during vertical displacement. Until this year, there was very little standardization and the vertical tracking angle of pickups varied from 0° to 40°. Most records were cut at an angle close to 0° and a large discrepancy between the angle of the vertical modulation on the record and that of the pickup could result in excessive harmonic and intermodulation distortion. This distortion becomes quite audible on records with extreme separation between channels, which is responsible for high levels of vertical modulation. Today, almost all stereo records are cut with the industry recommended standard of 15°, in the future all pickups will most likely be made to this standard.



Sonotone Mark IV—ceramic

The channel separation for frequencies below 8 kc is more than adequate in all cartridges. Above 8 kc the loss of separation is most apparent in the ceramic types.

Listening tests of average recorded music were for the most part inconclusive. When playing the outside band of a 12-inch LP, all cartridges sounded good. Occasionally a musical passage could be found — such as the combination of a tambourine and a triangle — that taxed the ability of some of the units. With all the Group I pickups the two instruments could be heard distinctly and separately; with the others



Weathers LDM—ceramic

the triangle was somewhat obscured or completely masked.

The specifications shown for each group do not apply exactly to each cartridge but the differences between cartridges within a group are small. END

Reverberation and Ambiophony

A famous British audioman explains some recent methods in commercial sound

By G. A. BRIGGS

THOSE TWO WORDS MAY HAVE A GOOD deal to do with the quality—technical and musical—of the next record you buy. They describe methods of electronically changing the acoustics of a hall—for getting rid of excess echo, or for adding it where sound is too flat and dull. Ambiophony is being used in Britain to let musicians in a treated recording studio hear themselves more as the broadcast listener hears them—and therefore help improve their performance.

Haas has shown that, due to precedence, when two or more speakers are in use, the listener appears to hear only the one nearest him, provided volume levels are similar, because sound from it is the first to reach his ears. This applies until the second speaker is more than about 50 feet farther from the listener than the first. Then the sound from the second speaker appears as an echo. This reduces the intelligibility. (56 feet = 50 milliseconds time lag.)

It follows that in assembly halls more than 50 feet long, we must avoid blurring the reproduction for certain listeners when several speakers are in use, say under balconies and in remote corners difficult to reach by the main speakers. This can be helped by controlling directional effects with column speakers, and by carefully adjusting individual volume controls connected to speakers judiciously placed. The desired effect is that the audience have the impression of listening to only one source of sound.

But in big places like cathedrals and railway stations with a high reverberation time, and with open-air activities over a large area, a time-delay system related to speed of sound and distance becomes necessary.

I think the 1952 Pamphonic installation in St. Paul's Cathedral must have been one of the first to be adopted.¹

¹ Parkin & Taylor, "Speech Reinforcement in St. Paul's Cathedral," *Wireless World*, Feb.-Mar. 1952.

Sound-delay equipment made by Philips. Tape runs around in circular loop; record and play heads are at left of circle. Central disc is calibrated in meters and carries the wording "10 meters = 30 milliseconds," so delay can be adjusted in terms of either distance or time.

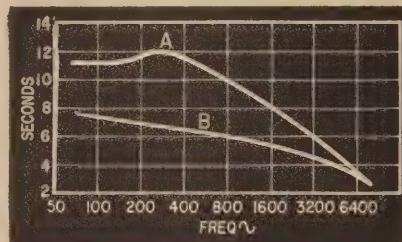
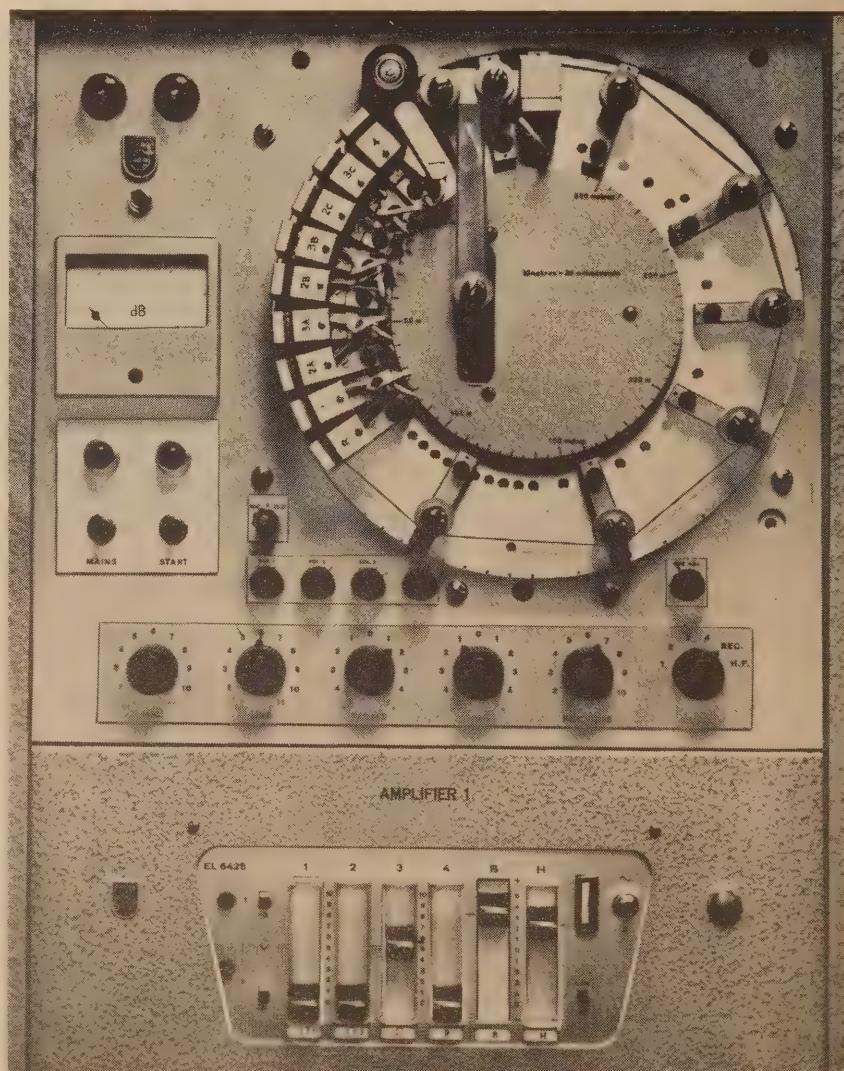


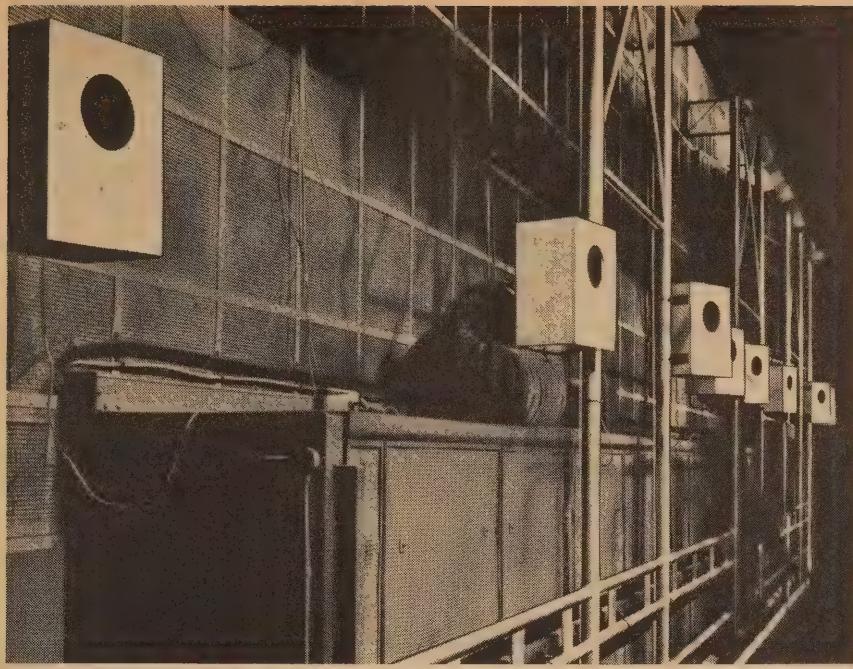
Fig. 1—Tremendous difference in reverb time between full building and empty one. This is St. Paul's Cathedral in London, with a volume of 5,000,000 cubic feet. Curve A is reverb time empty; curve B, full.

The difficulties were enormous, due mainly to a reverberation time of 6 seconds at mid-frequencies with full congregation (Fig. 1), large concave surfaces and a dome, producing strong echoes, and a time lag up to about 0.25 sec due to long distances.

Briefly, the acoustic problems were solved by column speakers with controlled directional effects, restricted frequency range of 250 to 4,000 cycles, and time-delay circuits for three pairs of speakers to correspond with distance (plus a few milliseconds).

It is interesting to note that delay times can be chosen to obscure the pres-





Part of ambiophonic system in BBC television studio. These speakers are some 25 feet above floor.

ence of additional speakers. This is done by allowing the supplementary sound to reach listeners between 10 and 14 msec after the original sound, bringing the Haas effect into play. (Very necessary, for instance, in open-air theatres.)

Delay equipment

The Philips EL6911 is a system for artificial reverberation as well as sound delay. In this kind of delay system, the original sound is recorded on a continuous loop of magnetic tape, which then passes a row of playback heads, one after another. The recorded sound can be picked off any or all the heads, and each successive head gives a longer delay between the original and the reproduced signals. In some models, delay can be adjusted precisely by sliding the heads along the tape. The tape loop is erased just before it reaches the recording head again.—Editor] Each of four delay circuits in the Philips has its own main amplifier to which appropriately placed speakers can be connected.

An interesting application of this equipment is to be seen—and heard—in the Central Station in Amsterdam. With its typical curved glass roof, this terminus has a decay time of more than 10 seconds. Column speakers were arranged in pairs down each platform, the delay being increased progressively toward the end, in step with the distance, thus eliminating echo effects.

Ambiophony

Time-delay systems are used to reduce echo and reverberation effects.

Artificial reverberation of many types is of course regularly added to recordings and broadcasts and is a day-

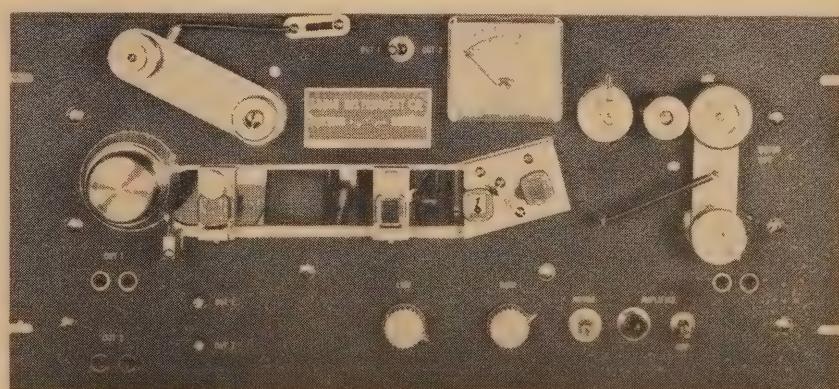
to-day practice like adding butter to bread. (On some pop records they seem to use lard!)

A rather novel application has been adopted in Studio-4 in the BBC Television Center. This is known as *ambiophony* and is mainly for use on broadcasts of orchestral concerts, the basic equipment being the Philips EL6911 described just now.

I am indebted to Mr. M. G. Foster of the Engineering Information Department of BBC for details of how the system works.

To reduce the inevitable background noise in a television studio during a broadcast, caused by moving cameras, microphones, staff, artists and often of scenery and properties, the acoustic treatment must be absorbent. This is satisfactory for most programs, especially drama and light entertainment, as in any case the acoustic climate of an individual scene is always modi-

Audio Instrument Co., New York, makes this tape time delay unit, model 1301A. Delays of 25 to 180 msec are available.



fied a little by the scenery.

When musical programs, particularly with large orchestras, are produced, absorbent acoustic treatment immediately makes itself felt. The reverberation time is much less than it would be in a normal concert hall or sound studio of comparable volume specifically designed for music.

Since the acoustic treatment is absorbent, there is little or no reflection of the sound of the orchestra from walls and ceiling, as there would be in a concert hall. This has a twofold effect. First, as far as the players and conductor are concerned the music they are playing appears to have a sound quality different from what they would normally expect, and that can affect their performance. Second, the listener—whether in the studio or over the air—is conscious of a general flatness of tone and lack of fully blended musical effect, which could be likened to the difference between listening to an orchestra playing in a good concert hall and then in the open air.

Studio 4 at the BBC Television Center has a reverberation time of approximately 1 second. According to accepted modern standards, a good concert hall or sound broadcasting studio of similar volume (357,000 cubic feet) should have a reverberation time of between 1.6 and 2 seconds.

In the past it has been common to attempt to overcome this in television studio acoustics by adding reverberation artificially, with an echo chamber or a reverberation plate. While this certainly improved the musical effect for the listener, it did nothing for the artists. Musicians playing in an acoustically "dead" studio are inclined to force their tone—especially the string section—with detrimental results to the performance.

In an attempt to produce controllable acoustic conditions in the studio itself, the BBC has been experimenting with the electronic system known as ambiophony.² This has involved install-

² R. Vermeulen, "Stereo Reverberation," *Philips Technical Review*, Vol. 17, No. 2, March 1956, p. 258.

ing of 62 speakers around the studio walls and in the roof space. Some of these are shown in the photo.

The speakers are fed with the orchestral sound through the time-delay device. They reradiate the sound much the same as the walls and ceiling of the studio would do if they were reverberant instead of absorbent.

Time delays are introduced into the speaker system so that each one "speaks" at the approximate time that the sound of the orchestra would take to reach the speaker's position in the studio, the first reproducing head being normally set to give a delay of 30 msec.

To imitate the randomness of true reverberation, the speakers are not connected strictly according to the delay appropriate to their position, although the correct general trend is maintained. The apparent reverberation time can be increased further by introducing artificial echo into the output of the microphone feeding the system.

The circuit provides some natural regeneration because a portion of the speaker output is picked up by the microphone supplying its input. It takes care to adjust the system for enough output from the speakers, but without acoustic feedback. This is usually

achieved by using two completely separate microphone placements, one for the broadcast and another to feed the ambiophony equipment.

The ambiophony mikes are generally much closer and are arranged to favor the string and woodwind sections of the orchestra, which are usually those affected most by deficiencies in studio acoustics.

Vocalist's microphones, particularly those that move about on booms, complicate the situation, since they will pick up the speaker output. As the ambiophony delay is designed to create a natural effect at the position of the orchestra, roving mikes might take up positions in the studio where the effect would sound most unnatural. Six of the speakers were therefore transferred to a separate circuit having no delay to enable players in the orchestra to hear each other more easily.

Though it needs more experimentation, ambiophony has already provided a significant improvement in the sound quality of serious musical programs on television.³

³ R. F. A. Pottinger, L. Salter, E. G. M. Alkin, and C. L. S. Gilford, "The Broadcasting of Music in Television," BBC Engineering Division, *Monograph No. 40*, Feb. 1962.

Ambiophony really relates to the technique of ambient sound, and it is made clear by Philips that there are many directions in which it can be applied. For instance "dead spots" in older theaters and public buildings can be filled effectively by speakers which—if used without suitable time delays—would merely make things worse. Artificial echo effects can easily be added to outdoor sound reinforcement at open-air theaters, "Son et Lumière" (Sound and Light") plays, concerts, etc.

To prolong the reverberation time to the order of seconds, the signal from the last of the eight playback heads is returned to the recording amplifier via an attenuator, so that the closely spaced pattern of reflections is repeated at a lower level. The attenuator control determines the decay rate.

The initial delay—largely responsible for the impression of auditorium size—depends on the position of the recording head relative to the playback heads. It can be changed in a few minutes.

Thus, with this type of equipment, ambient conditions can be enlarged, enlivened or subdued to suit the type of program and the discriminating faculties of the human ear.

END

Nomograph Scale Chart

It is easy to make logarithmic scales of any length to construct a nomograph. Just copy the B- or C-scale markings from the slider of a

slide rule. Then draw a line at a right angle from one end of the copied scale. Use a line length that is easily divided into the length ratio needed.

For example, if a logarithmic scale one-half or one-quarter as long is needed, 8 inches would be a good length for a base line. If you need something like two-fifths or seven-tenths, then 10 inches would be a better choice. For two-thirds, it would be better to use 6 or 9 inches. Some odd fraction divisions must be stepped off with a divider.

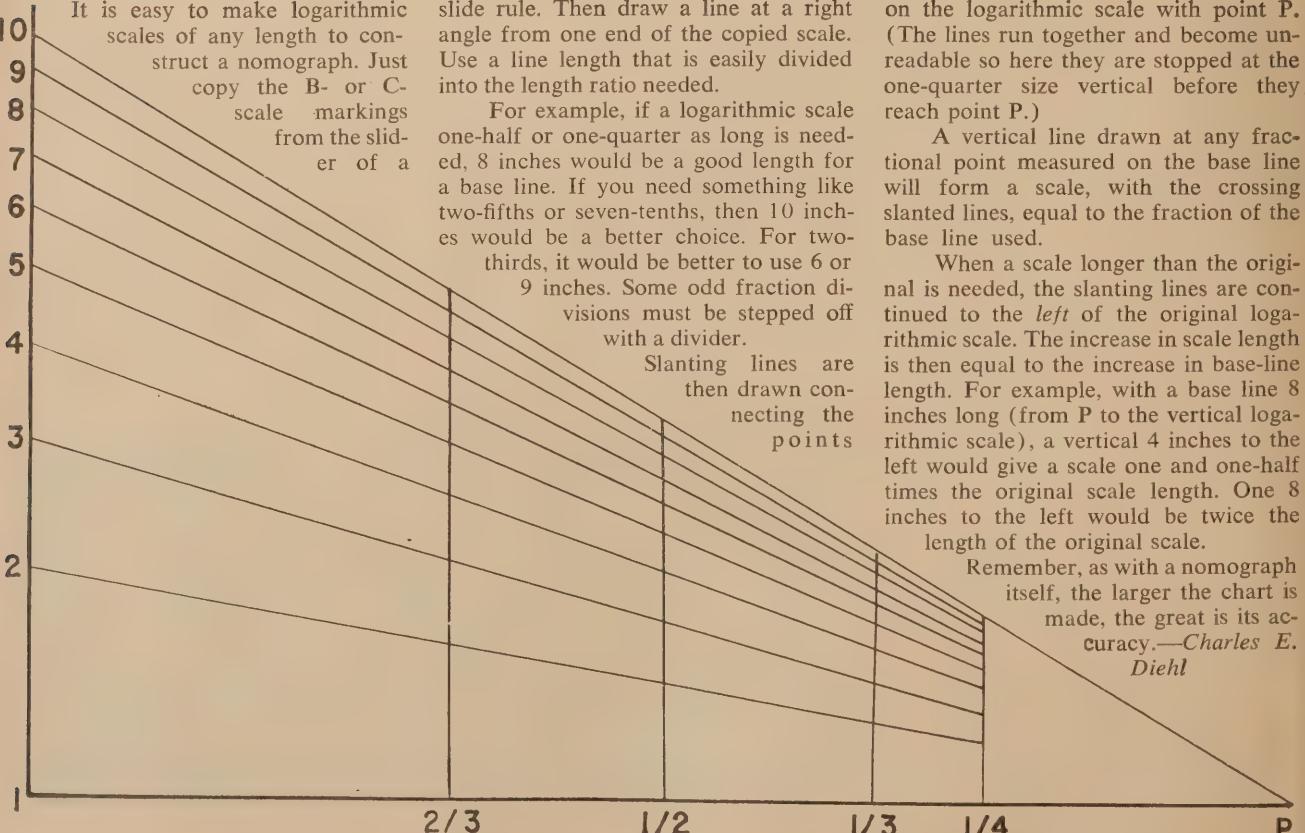
Slanting lines are then drawn connecting the points

on the logarithmic scale with point P. (The lines run together and become unreadable so here they are stopped at the one-quarter size vertical before they reach point P.)

A vertical line drawn at any fractional point measured on the base line will form a scale, with the crossing slanted lines, equal to the fraction of the base line used.

When a scale longer than the original is needed, the slanting lines are continued to the left of the original logarithmic scale. The increase in scale length is then equal to the increase in base-line length. For example, with a base line 8 inches long (from P to the vertical logarithmic scale), a vertical 4 inches to the left would give a scale one and one-half times the original scale length. One 8 inches to the left would be twice the length of the original scale.

Remember, as with a nomograph itself, the larger the chart is made, the greater is its accuracy.—Charles E. Diehl

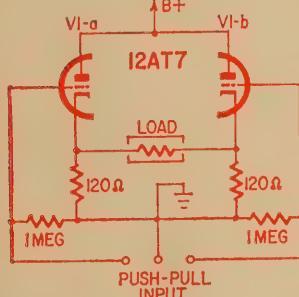


Some Simple But Unusual Circuits

By GEORGE J. RUPP

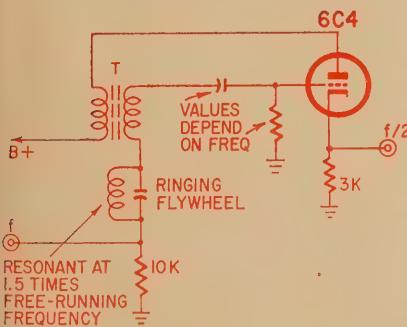
In this age of circuit sophistication, we may overlook simple circuits that can be just as useful and interesting as complicated ones. Here are some that stay alive.

DIFFERENTIAL CATHODE FOLLOWER



With no signal applied, the voltage at the two cathodes is equal and no current flows through the load. The noise is low. An advantage of this circuit is the protection furnished the load. One triode (V1-a, for example) is driven to saturation while the other (V1-b) is cut off when the input is excessive. The current of the conducting stage (V1-a) must flow through its cathode resistor (120 ohms in this case). The load (often several thousand ohms) and the opposite cathode resistor are in series across the conducting cathode resistor. Hence only a fraction of V1-a's current flows through the load.

STABILIZED BLOCKING OSCILLATORS AS FREQUENCY DIVIDER

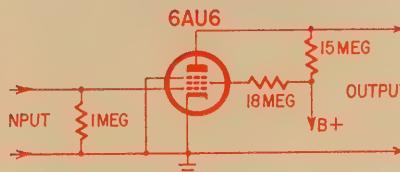


This circuit can be used to divide a frequency by 2. The "flywheel" (which should have fairly high Q) rings above the free-running frequency of the blocking oscillator, and stabilizes the circuit.

Every second alternation of f triggers the blocking oscillator, which usually operates at $f/2$. The "divided"

result is taken from the cathode resistor. This circuit is useful to several hundred kc with proper choice of components. Transformer T can be a 1 to 1 coupling or blocking oscillator transformer.

STARVED AMPLIFIER



The starved amplifier produces high gain at low noise. Gain is high because of the large plate load, and noise is low because of the low voltages applied to the elements.

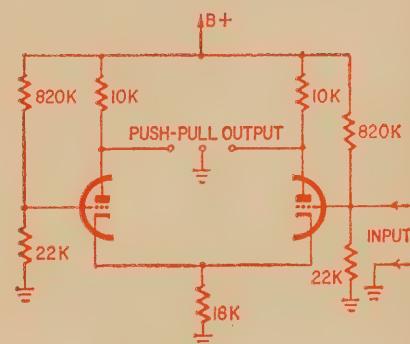
The amplification of a stage depends on the ratio of the load resistance to the plate resistance (R_p). So, even though current through this stage is low, the gain is high, often over 1,000.

A disadvantage is that the stage has very poor high-frequency response —7 or 8 kc is usually the upper limit.

Eureka navigation aids (Loran). The aircraft interrogator (Rebecca) sent pulses which triggered a land beacon (Eureka).

The plane then received pulses from the beacon, and the delay between transmitted and received pulses gave the navigator the distance between his ship and the beacon. Two beacons on different frequencies had to be interrogated for the navigator to vector his position, which could often be done with surprising accuracy.

LONG-TAIL INVERTER

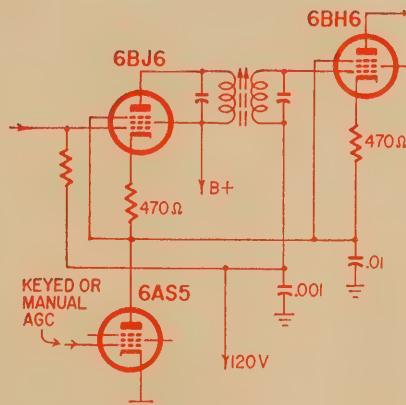


This phase-splitter circuit can also be used as a differential amplifier.

Any noise pickup or changes in power supply voltage tend to cancel out in a differential amplifier. This circuit finds use as a dc amplifier in computer circuits, and as a phase inverter in audio amplifiers.

END

AMPLIFIED AGC



The 6AS5 pentode in this circuit acts as a variable resistor, much like the series pentode regulator tube in a regulated power supply. When the voltage on the grid of the pentode is varied (manually with a pot or automatically by signal strength), the voltage of the first and second i.f. stage cathodes is also varied. That offsets or aids the fixed positive voltage on the grids (120 volts). Voltages must be juggled to get the correct bias range on the amplifier grids.

In one application, the grid of the pentode was fed to a pot which was called I.F. GAIN. This plus a tunable infinite-rejection wavetrap in the rf helped overcome enemy jamming and random noise in the early Rebecca-

Radio-Electronics to Publish Special Test Equipment Issue

The November issue of RADIO-ELECTRONICS (out October 20) will be a Special Test Equipment Issue.

Every important aspect of Test Equipment will be covered. Articles will describe what test equipment you need for a good and efficient service shop, with a check list for an ideal set-up. There will be features on how you can use test equipment to save time—and how to make the best use of your vtvm, your vom, your scope. The issue will contain reports on new test equipment and a rundown on stereo multiplex generators. Stories on instrument construction and modification will also be featured.

In addition to the test equipment section, many other articles, features and regular departments will appear in next month's RADIO-ELECTRONICS.

PROFITS IN ELECTRONICS AFLOAT

Troubleshooting depth sounders, and tips on installing sounders, radios, noise elimination

By ROBERT C. BEARD

SHIPS' HAILERS, INTERCOMS, RADIO DIRECTION finders and other gadgets pose no special service problems. Even Consta-volt and other battery charging systems are simple transformer-rectifier circuits.

Depth sounders combine mechanical, electrical and electronic functions, and sometimes frustrate the novice repairman. In flasher type sounders, a constant-speed motor rotates indicator arm carrying neon bulb and pulse contactor. At point of contact, bulb is at zero dial position, and oscillator operates momentarily to produce ultrasonic pulse (75 to 200 kc, depending on model) a few cycles long. Pulse passes through amplifiers, flashing neon bulb at zero. It also goes to transducer, producing momentary mechanical vibration, which passes through water to the bottom. The minutely small signal reflected to boat from water bottom reaches transducer after indicator arm has moved past zero. Oscillator is now inoperative and the small electrical signal developed in the transducer by the returning vibration (reflected from bottom) is amplified and used to flash the bulb again. Position of bulb past zero is determined by travel time of mechanical signal from transducer to bottom and back, which in turn depends on distance to bottom. For constant motor speed, you get accurate depth calibration.

Instead of the pulse contact, some sounders have a permanent magnet attached to the end of the rotating arm. The magnet produces the pulse as it passes closely over a coil mounted behind the arm.

Many sounders are powered with synchronous vibrators. Such vibrators must be replaced with identical units to avoid false calibration due to change in motor speed.

Most common sounder repair is bulb replacement. Bulb glass darkens with use, dimming flash even before bulb failure; thus the bulb's physical appearance is an indication of its usefulness. Three types of bulbs are in common use. White Echo Sounders use bayonet-base NE-51H, replaced by removing dial front.

Fig. 1 shows NE-2 or Sonar type bulb correctly positioned on the rotating arm. A small rubber band holds bulb in place while regular Duco cement dries. Wires are soldered to printed conductors on opposite face of the arm, and polarity between the two conductors and bulb electrode facing arm must be maintained as shown. Rotate arm manually after installation to be sure nothing hits, but don't operate sounder until cement is thoroughly dried (overnight), or centrifugal force will tear the bulb loose. Bendix type bulb (Fig. 2) is replaced in much the same way, except that a metal clip holds bulb at the cementing point. Polarity is no problem with this type.

Most sounders operate from boat batteries, but some transistor models use internal batteries. Sonar D-60 uses boat battery to run motor and an internal battery for circuit power (Fig. 3).

The oscillator coil sometimes fails due to internal breakdown caused by high pulse voltages. This is difficult to diagnose directly; but if all signals are absent, yet amplifiers are working, oscillator is defective. If all other oscillator components check OK, direct substitution of oscillator transformer is the final test.

If sounder shows zero flash but no depth reading, look for trouble in transducer or cable. By removing cable and poking a metal object into the sounder's "hot" transducer terminal while it is running, you will produce random flashes all around the dial if amplifiers are OK.



Fig. 2—Special neon bulb in Bendix DI-5 depth sounder.

A strong zero flash indicates oscillator is working, and the trouble is below. Execute test quickly, because operating sounder without transducer causes high pulse peaks, and can cause premature oscillator transformer failure. If cable and fittings are good, transducer is faulty and must be replaced. Usual failure here is separation of plastic face from transducer element, leaving an air gap the vibratory signal won't cross. If this has happened, tapping or squeezing the plastic surface will produce a hollow sound or spongy feeling.

A bright zero flash with weak depth reading usually indicates dirt on transducer face is reducing sensitivity. Scrape dirt off very carefully without scratching plastic; never use sandpaper. Transducers must not be painted with metallic bottom paint, though plastic type anti-fouling paint may be used without affecting sensitivity.

Radar, automatic direction finders, loran and autopilots have complex circuitry and are very sensitive. Since relatively few are in use (compared to radios and sounders), familiarity with their designs and troubles will come gradually. Work from manuals when first servicing or installing such equipment.

Installing equipment

Although most boatyards sell electronic equipment, they can do only part of the installation, and prefer to contract



Fig. 1—Sonar indicator bulb is similar to NE-2, but has longer life. Here it is shown properly installed. Note the position of the electrodes.

such work to radio men. Explain to yards you serve the importance of service accessibility to equipment they install. Advise them to keep antennas as close as possible to radiotelephones, and give them other technical installation details which will give the customer a better job and facilitate future service.

For installation work, carry these tools and materials: No. 8 plastic-covered stranded wire for battery lines, GTO15 neon sign wire for antenna leads (black or clear), plastic wire clips for GTO wire and bronze staples for the No. 8, variety of chrome-plated brass wood screws, tube of marine sealing compound (compound should be put under every object or around every screw fastened to boat), crimping pliers and solderless terminals to fit your wire and supply of fuse blocks and fuses (10 to 30 amps). An electric drill is necessary; a cordless drill is ideal because it elim-

inating damage when boat is not in use.

A good antenna is worthless with inadequate ground. Small, porous bronze ground plates are easy to install, but not electrically equal to 10 or 12 square feet of copper, regardless of claims. A good ground consists of copper sheets as wide and long as possible on each side of keel, with copper through-bolts connecting them. A copper strip goes from them to a bolt through the hull, to which all ground connections inside the boat are made. Since boat must be hauled out for ground-plate installation, yards usually do the entire job, but will welcome suggestions.

If keel is too small for sufficient copper area, the conventional method of attaching copper sheets to the hull bottom is good electrically, but subject to damage from floating debris. Sheet ground plates may be painted with bottom paint, but porous plates must not, as

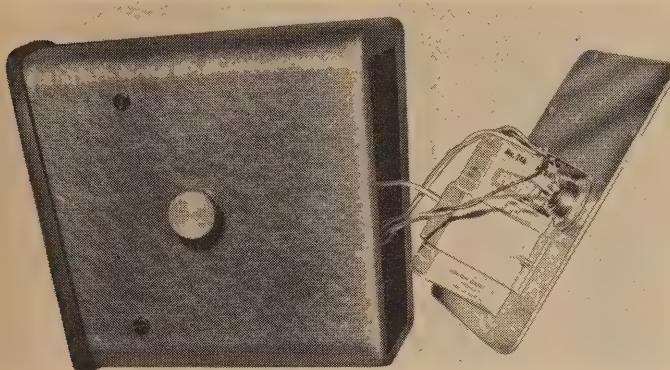
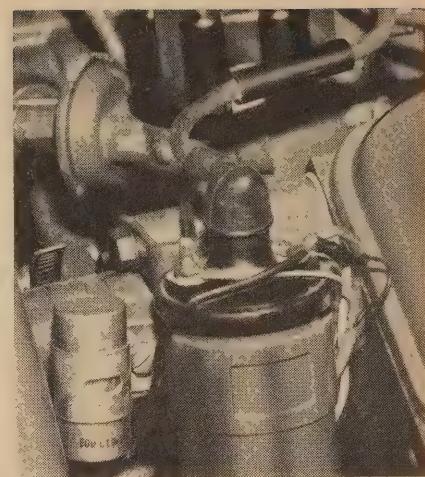


Fig. 3—Circuitry of Sonar D-60 is powered by internal battery inside housing. Boat's batteries operate motor.



inates need for shore power.

Installing radiotelephone requires considering owner's location preference, battery line length, length of antenna lead and service accessibility. Never place equipment nearer than 3 feet to the compass without reminding the owner that a compass check should be made afterward. If battery leads must pass closer to compass, twist them together to cancel their magnetic fields.

A fuse of recommended size should be installed in "hot" battery wire (usually positive, but a few boats use positive-grounded systems.) All connections must be very tight and sprayed with CRC* to prevent corrosion.

Antenna lead should be as short and direct as consistent with appearance. Avoid long, parallel runs close to other wiring or metal objects. Place antenna as high and clear as possible—never very close to metal masts or guy wires. Longer antennas (19–24 feet) are much preferable to shorter ones (13–18 feet). Lay-down mounts are safety devices not only to permit passing under low bridges and covered slips, but also to prevent light-

paint will close pores, reducing the plates' already limited effectiveness.

If a new ground system is installed on an existing radio installation, retune the transmitter.

After installation, put in all crystals, making sure to label channels on front panel. Peak receiver crystals according to manual (usually two trimmers per channel), then tune transmitter as previously described. If transmitter has no rf output meter, do all peaking with field-strength meter while watching milliammeter for proper plate current. Keep each on-air tuning adjustment very brief to minimize interference.

Frequency and modulation checks come last. Any crystals outside .02% tolerance must be replaced before certification. Modulation percentages from 80% to 100% are generally acceptable, since most rigs have no modulation adjustment. If below 80%, service is required, checking first tubes or transistors, then voltages. Peak limiting is automatic, and most new rigs will show 92% to 98% modulation. Either make your certification in radio's log or prepare your own printed certification slip with duplicate copy for own file.



Fig. 4—Three standard spots to install noise suppression: coil (top), generator (center) and regulator (bottom).

Installing depth sounders

Depth sounders usually are installed by boatyards because boat must be hauled out for transducer installation. Never lengthen or shorten the transducer cable; it is part of the oscillator's tuned circuit. If cable is too short, factory can supply special cables. Excess in long cables is simply coiled and stowed neatly.

Visibility of indicator dial and serv-

*CRC, 116 Chestnut St., Philadelphia, Pa.

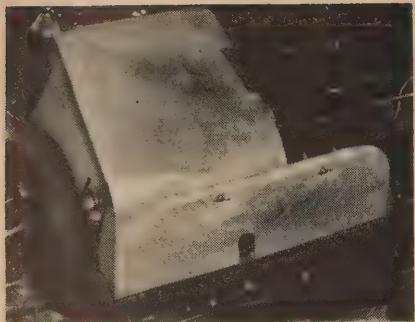


Fig. 5—Ignition noise shields are held on marine engine by valve cover wing nuts. Shields extend below line of spark plugs and their wiring.

ice accessibility must be considered. Indicator unit must be 2 feet from compass if at all possible. Twist battery wires if they must pass close to the compass.

Noise elimination

In any radio installation, install basic noise suppression (Fig. 4): 1- μ f capacitors to ground from coil battery terminal, generator armature post, and voltage regulator armature and battery terminals; suppressor in high-voltage coil wire. Suppressor plugs or plug wires may be used. Never connect capacitors to field posts of generator or regulator.

These items will clip sharpest noise peaks, but rarely quiet radio. Next step is to install aluminum shields around all high-tension engine components: coil, distributor, spark plugs and plug wires. Commercially made shield sets for specific engines are available, but you can make your own from sheet aluminum if you are handy with snips. Shields must fully enclose parts mentioned and be well grounded by attaching to engine bolts. This will quiet most radio noise (Fig. 5).

For absolute quieting, installing complete shielded ignition sets is necessary. These include new shielded coil, distributor cap, plug shields, shielded high-voltage wires. Made to order to fit specific engines, they are very expensive.

Routing antenna lead away from the dashboard will reduce noise pickup from ignition switch wires. Sometimes it is necessary to shield those wires. Tight wiring connections throughout boat and positive grounding of all equipment and large metal objects to ship's ground will minimize interference.

Radio noise from accessories (windshield wipers, bilge pump, etc.) is usually killed by connecting a 1- μ f capacitor across battery line at accessory.

Depth sounders are also subject to interference. Ignition can produce intermittent or periodic flashing all around

indicator dial. All precautions apply to this interference as well as to radios. Another interference source for sounders is cavitation, or air bubbling over transducer surface. This will occur if transducer is mounted too far forward on the hull. As boat picks up speed, air passes under hull with water and, as bubbles pass transducer, they may cause flashing on the dial. It will look like ignition noise, but can be distinguished by its presence only when boat is well under way. It will not occur at rest, even with motors running.

Most marinas and boatyards will order and pay for your services, rather than individual boat owners, so they can control quality of work done for customers. This also eliminates most collection problems. You'll find the yards very cooperative when you need help. Always let them supply a pilot when you run a boat for testing.

Your shoes *must* have rubber soles and heels; some deck surfaces mar easily, besides being slippery when wet.

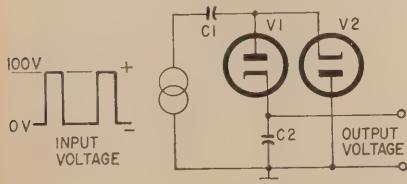
Many boats represent large investment and a heavy mortgage. Owners are often perfectionists, and won't tolerate carelessness around their craft. If you are prompt, dependable, competent and careful with other people's property, you are assured of long-term, money-making repeat business on boats. END

What's Your Eq?

Conducted by
E. D. CLARK

Step Up to the Counter

In a step counter with a square pulse input of 100 volts peak from a square pulse generator, there are two capacitors and two diodes (see schematic). $C_2 = 9 \times C_1$. The square pulse



generator has zero impedance when the output voltage is zero. Voltage drop across the diodes is negligible when they are conducting. When the output is taken

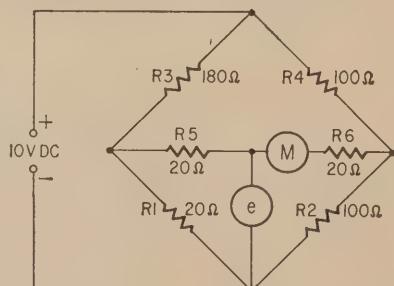
Three puzzlers for the students, theoretician and practical man. Simple? Double-check your answers before you say you've solved them. If you have an interesting or unusual puzzle (with an answer) send it to us. We will pay \$10 for each one accepted. We're especially interested in service stinkers or engineering stumpers on actual electronic equipment. We get so many letters we can't answer individual ones, but we'll print the more interesting solutions—ones the original authors never thought of.

Write EQ Editor, Radio-Electronics, 154 West 14th Street, New York, N. Y. 10011.

Answers to this month's puzzles are on page 99.

across capacitor C_2 , what will the output voltage and waveform be for two input pulses?—David Levine

Bypasses and Bypasses



Problem: Find current through M , and also find voltage "e".—E. D. Clark

Phase Angle

An inductive reactance of 8 ohms

is connected in parallel with a capacitive reactance of 18 ohms. This combination is then connected in series with a variable resistor. For what value of resistance will the power factor be 0.5?—Joe Penny

50 Years Ago

In Gernsback Publications

In October, 1914,

Electrical Experimenter

Electrical Entertainments, by H. Winfield Secor, A.M., I.R.E.

Experimental Electricity Course (Lesson 14), by S. Gernsback & H. Winfield Secor.

Rotary Adjustable Variable Condenser, by Frank H. Broome.

The Colin-Jance System of Radio-Telephony.

Experimental Wireless Telephone, by Paul Shney.

A Non-Inductive Potentiometer, by Clifford H. Burr.

A Variable Condenser, by Edgar Felix.

Improved Electrolytic Rectifier, by Alfred Heinz.

Radio Laboratory of Delbert Myers.

New, Higher-Fi Stereo Disc Cutter

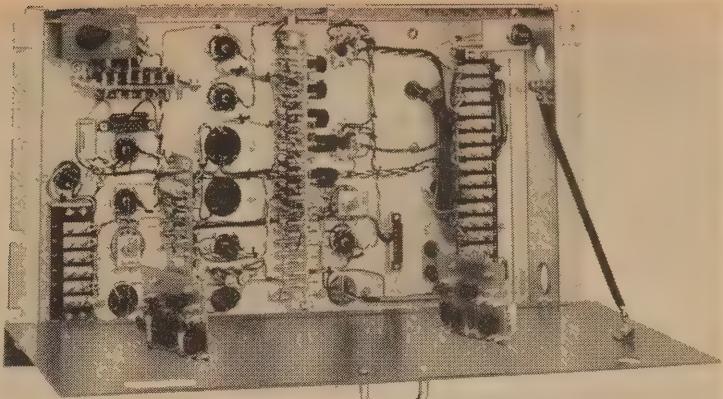
By G. L. AUGSPURGER

LATEST VERSION OF FAMOUS WESTREX SERIES CUTS CLEANER STEREO DISCS.

AN IMPROVED STEREO DISC CUTTER AND associated 75-watt driving amplifiers, the 3D StereoDisk System, has been announced by the Westrex Div. of Litton Industries.

The new components were shown and demonstrated at the spring 1964 Audio Engineering Society convention in Hollywood.

The new cutter includes a number of improvements in performance and ease of operation as compared to West-



Inside one of the two newly redesigned drive amplifiers. Each can supply 75 watts with less than 1% distortion over the range of 30 to 15,000 cycles. Plug-in equalizer "cards" stand on edge on dropped-down cover of amplifier.

rex's previous model 3C. Of primary interest to high-fidelity enthusiasts are the 3D's increased dynamic range and smoother frequency response, especially in the high-frequency range. Westrex claims that the 3D system can make a recording which exceeds the capabilities

of even the best pickups presently available.

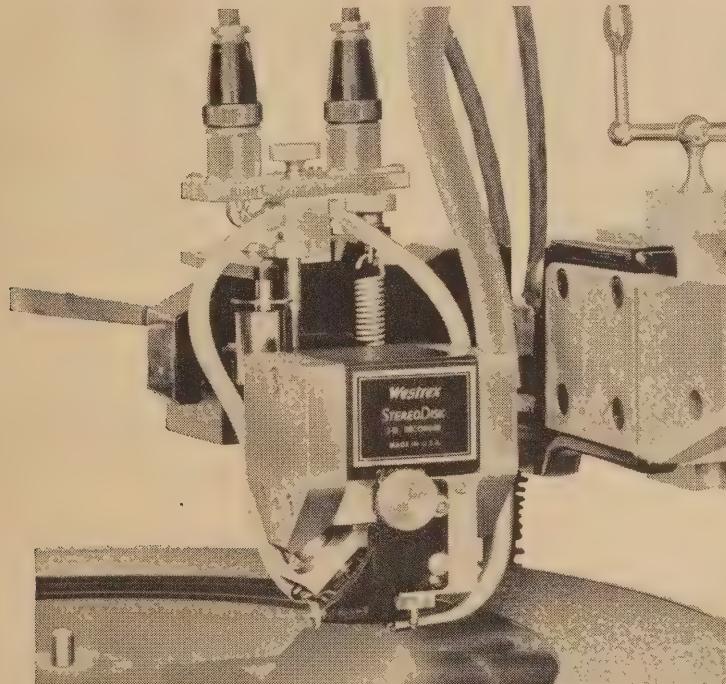
Record companies can have their earlier-model Westrex cutter systems altered to the new configuration, and it is expected that they will do so. Because a high percentage of domestic stereo records are cut with Westrex equipment, owners of stereo reproducing systems will ultimately benefit from the change-over. Recording engineers will be glad to know that the I^2R losses in the new cutter have been reduced by 25%, increasing overall efficiency by the same amount.

One interesting point, in view of the recent interest in a standarized 15° vertical cutting angle (see *RADIO-ELECTRONICS* March 1964 cover story, page 32), is that the Westrex 3D cutter retains the same 23° vertical stylus angle as its predecessors. According to Westrex engineer C. S. Nelson, the cutting head can be mounted to give any desired vertical angle, but the decision about which to use is considerably more complicated than the average audiophile is apt to realize.

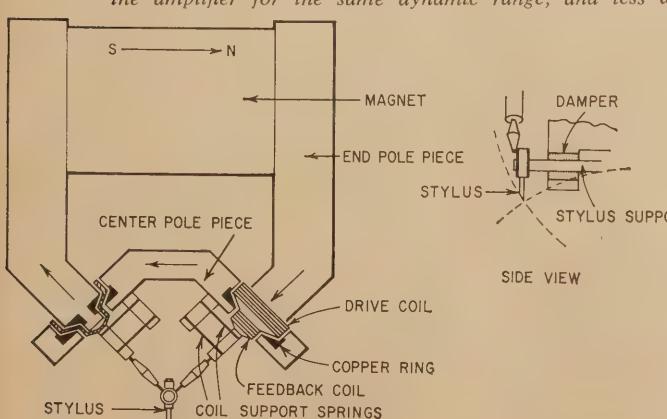
"Because of the forces involved during the cutting of the master disc, the effective vertical angle at which the groove is cut may possibly be only 15° even though the geometrical angle of the cutting stylus is considerably greater," said Nelson.

I checked with a number of other recording engineers and pickup manufacturers, and they agreed that while standardization of the vertical cutting angle is desirable, the problem is not as cut-and-dried as some recent publicity would indicate. One cartridge manufacturer even stated that he had experimented with wide variations in vertical playback stylus angles with no significant differences in performance.

Westrex's position is that, when the recording companies ask for a different cutting angle, it will be a simple matter to produce it by the way the cutter is mounted to the recording lathe. In the meantime, the model 3D will retain the same internal geometry as the previous Westrex stereo cutters.



New Model 3D cutter is 25% more efficient than previous model. That means less heat loss in drive coils, less driving power from the amplifier for the same dynamic range, and less distortion.



Basic design of Westrex 3D stereo recording cutter

MORE ON HOW TO REPAIR ROTATORS

How to fix stuck motors and jammed parts, how to make manual rotators automatic, and how to work with insurance-covered installations

By HOMER L. DAVIDSON

IN THE AUGUST ISSUE, WE SAW HOW MANUAL AND AUTOMATIC antenna rotators work, and talked about some of the things that go wrong with them. Now let's find out what to do about the troubles.

A defective motor will read open in a continuity check, or will not turn, only hum, or nothing happens at all. Fig. 1 shows the location of a rotor motor in the motor assembly unit. Remove the six bolts from the motor assembly, pull off the drip cap and pull the assembly apart. In most cases the rheostat has become worn and has opened. This will be found by a continuity check.

You will be able to see if gear teeth are broken out (by

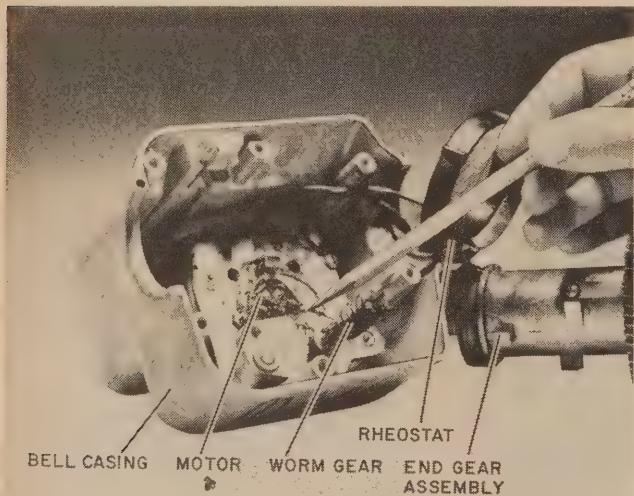


Fig. 1—Where the motor is in this rotator. Gears must be removed to get at it.

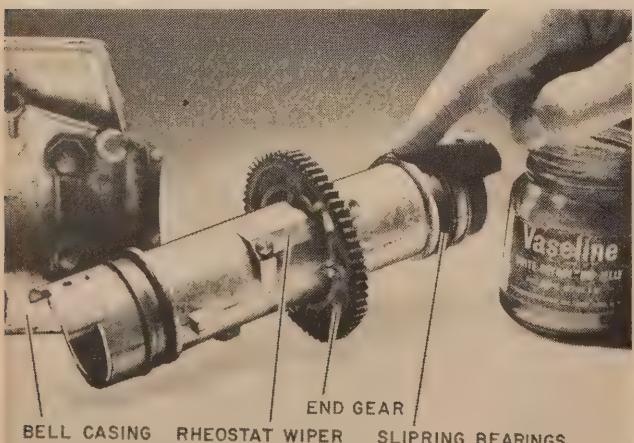


Fig. 2—Grease slip-ring bearings with light grease or petroleum jelly.

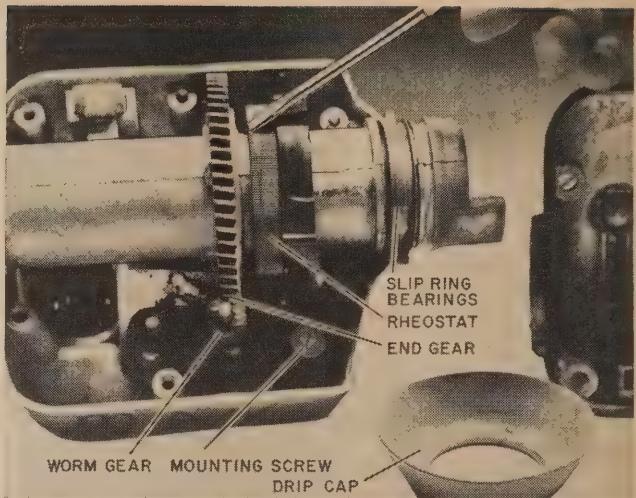


Fig. 3—"Stripe" on rheostat winding shows serious wear, and end-gear teeth, too, show signs of long, hard use.

wind damage) or if the gears are "frozen," simply from being dry. In many cases, motor bearings become dry and just will not let the shaft turn. Use a heavy grease or petroleum jelly to lubricate them and the gear. Fig. 2 shows how lube is applied to the slip-ring bearings and gear assembly.

The rheostat assembly is removed by taking out one mounting screw. Fig. 3 shows the rheostat assembly; the mounting screw is in the lower right corner of the motor unit.

Pull the gear assembly and rheostat out together. If the rheostat is bad, replace it. Very rarely does the motor itself go bad, but in one case the motor had a short between windings and frame. Continuity on the outside was good at this point, but the motor would not turn, only hum. In such a case unsolder the leads from the motor and check continuity from windings to the motor frame. Motor assembly and bearings should always be greased before the unit is put back together, regardless of the trouble.

When the direction-indicator meter is erratic at a certain part of the scale, the rheostat in the motor assembly is very badly worn, or a lot of grease has run up on it, making a poor connection.

If many motor assemblies are around your shop, it is wise to mark them with a crayon, identifying manual and automatic units.

Most of the troubles that develop in automatic rotators are the same as those that come up in manual models. A trouble peculiar to automatics is in the pulsing step relay. Sometimes it will get out of step with the motor unit. Generally this happens when the operator changes the direction of the control unit while the rotator is moving. To get the automatic rotator back in step, it is best to turn the control to the north position in a clockwise direction. Let the relay indicator hand go until it stops. If the hand stops before it reaches north, simply reach under the control box and trigger the relay to the north position. The light will also go off when this is done properly.

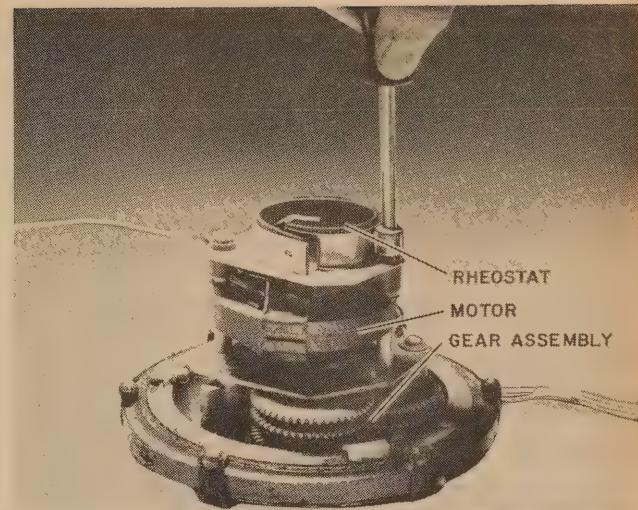
If the unit does shut off without any trouble, rotate the pointer to the other north position, counterclockwise. If properly synced, the unit will stop and turn the light off. The correct way to operate an automatic rotator is to let the rotator finish its rotation and stop. Then start up in a new direction.

Other automatic rotator troubles are poor switching contacts in the motor assembly, a bad relay and poor contact on the slip-ring contacts in the control box. While the unit is apart on the bench, clean the pulsing contacts in the motor assembly and the switch contacts in the control box.

A few do's and don'ts and hints may be helpful. On hooking up the rotator cable to the motor and control box, use the silver wire as a guide. Many technicians when hooking up the Alliance rotator use the silver wire as No. 3, then wire Nos. 1, 2 and 4. This is done because the first connection on the motor hookup is closer to the worker. It really doesn't matter in what sequence the wiring is done as long as this system is used all the time. Wire every rotator the same way with respect to the silver wire. Be sure that the rotor is a north-to-north or south-to-south unit.

Be sure the antenna is pointing in the same direction as the rotator, when you install it on the roof. When you replace the gear assembly, be sure that the wiper blade is on top of the rheostat in the manual motors. It is easy to put the motor together with the blade left below the point of contact. When replacing the two assembly shells, snug one bolt on one end and then snug the other bolt opposite this one so that the units will not bind when placed together.

All control-box capacitors can be replaced with 70- μ f 50-volt ac units. A test cord can be made out of four-wire rotator cable by putting spade lugs on each wire end. If you use alligator clips, color-code them. When the rotator job is completed, run the rotator completely around once. Some-



A CDR-Radiart rotator motor, with rheostat on top.

times a motor will bind or the antenna wire will wrap around the pipe and the motor will not turn completely in both directions. And just before you leave, show the customer how the rotator works and let him operate the unit while you are there to help him.

Insurance

Many home owners who have a wind-damaged antenna and rotators are covered by insurance. Sometimes the customer does not know this; it should be called to his attention. There is a homeowner's or "package" policy that covers antenna and radio-TV equipment. With these policies there is no coverage limit. They are a part of the house policy. Details vary from state to state, but the policies are basically the same.

Another type of insurance is the add-on policy to the present household or personal insurance policy. An existing radio and TV business that now wants tower and antenna coverage against wind damage can have this coverage added to the present policy.

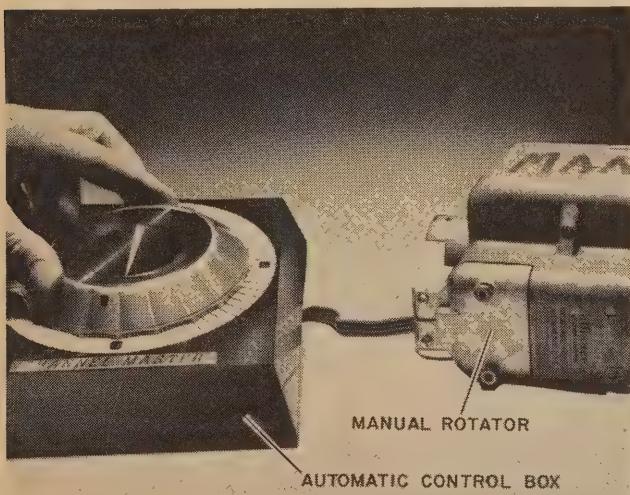
The average charge rate is \$5 per hundred per year. If you wanted your tower and equipment insured for \$150 per year, the cost would be \$7.50, in addition to whatever premium you now pay. A man who rents an apartment and owns his own antenna can take out a tenant policy for wind damage.

It is best for the TV technician to get clearance from the insurance company or its agent before starting repairs if the rotator is covered by insurance. Sometimes the insurer will want a rough bid on what the complete job will cost. In most cases, the insured party rather than the service outfit will get the insurance check. Again, this varies with the local insurance agents.

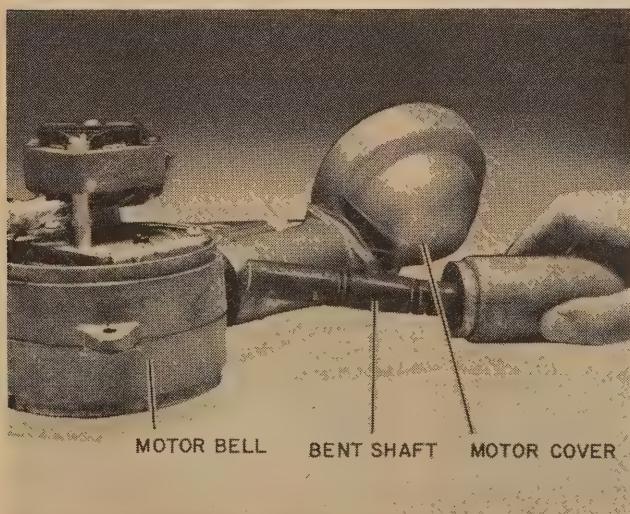
Automating

An automatic rotator control box has been placed on the market to make most manual motors operate automatically. This is the Channel Master model 9526. It was designed to work with manual motors at a 1-rpm rate.

When a manual control goes bad, it is often a good idea to replace it with the automatic. (Check to see that the rotator is adaptable to the control—some manufacturers point out that their rotators are built to operate at a different voltage than that supplied by the 9526, and that therefore operation may not be good.) Here is another new-business potential within the grasp of the technician who installs antennas!



Channel Master's 9526 control box with an Alliance rotator motor.



What a strong wind and a heavy antenna can do to a rotator shaft.

THE HUM SNIFFER

This sensitive instrument, using a prefab transistor amplifier, tracks down all sorts of hum and noise troubles

By LYMAN E. GREENLEE

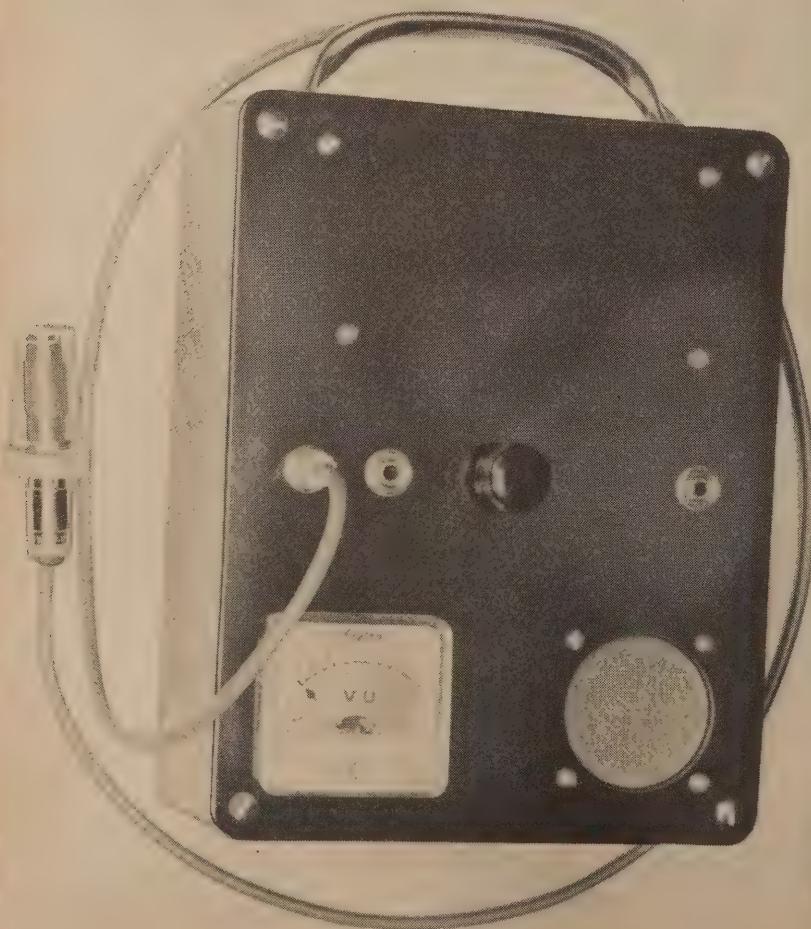
Hum is a nasty word if you are working with hi-fi equipment. Finding and eliminating it can be time-consuming without proper instruments. Since they aren't usually cheap and handy, the solution is to build your own!

The hum checker in this article is built around Lafayette's model PK-544 5-transistor miniature push-pull audio amplifier. Output is 360 mw, with an input of only 300 μ V. The amplifier is very inexpensive, and using it makes construction easy. Everything fits neatly into a stock Bakelite instrument case without crowding. It is battery operated so no hum gets into it from the power supply.

Uses of the Hum Sniffer include checking shielding for effectiveness, tracing paths of hum currents in chassis, orienting power transformers and chokes for minimum hum transfer, routing ac wiring for paths of minimum hum, searching out hidden power lines, locating power leaks, and as an ac voltmeter. With a diode input probe, the amplifier is also an excellent signal tracer, particularly useful for servicing transistor amplifiers.

Fig. 1 shows the block diagram of the amplifier. Fig. 2 shows the connections for the two input jacks, to allow connection to either the first or second transistor, depending on the amount of

Hum sniffer in its plastic case, about 5 x 7 x 2 inches, is easily portable.



gain required. Note that J1 is wired to short the input when the plug is removed. J2 opens the circuit between the first and second stages when the phone plug is inserted. The green wire to the volume control is broken at the X on the diagram (Fig. 1) and J2 inserted there.

Connections to the output phone jack (J3) are shown in Fig. 3. Note the 10-ohm resistor R in series with the speaker voice coil. This resistor is required to get a full-scale reading from the VU meter. If a different speaker than the one specified is used, it may be necessary to change the value of this resistor to something between 5 and 15 ohms to obtain the required full-scale meter reading. The meter should read full scale with an input signal of 300 μ V. Plugging an earphone into output jack J3 will alter the meter reading, but this will be of no consequence.

All parts except the battery can be conveniently mounted on the front panel. The amplifier and accessories should be placed in position as shown in the photos, and outlined with a pencil as a guide to drilling mounting holes. Parts layout is not critical and may be varied to suit your ideas.

It is a good idea to check out the amplifier by hooking it up temporarily before fastening it permanently to the panel. In fact, let it run for at least a couple of hours with a signal input to see that no parts are going to fail prematurely. The battery can be mounted in the bottom of the case with a strip of

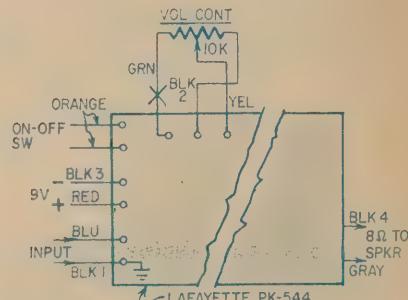


Fig. 1—Lafayette PK-544 transistor amplifier comes complete except for speaker, battery and volume control. Here's how to wire it for use in the Hum Sniffer.

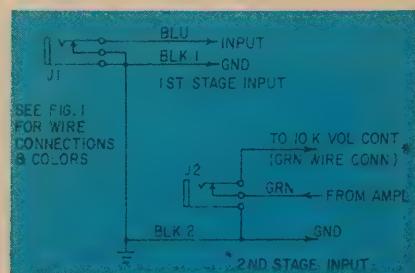
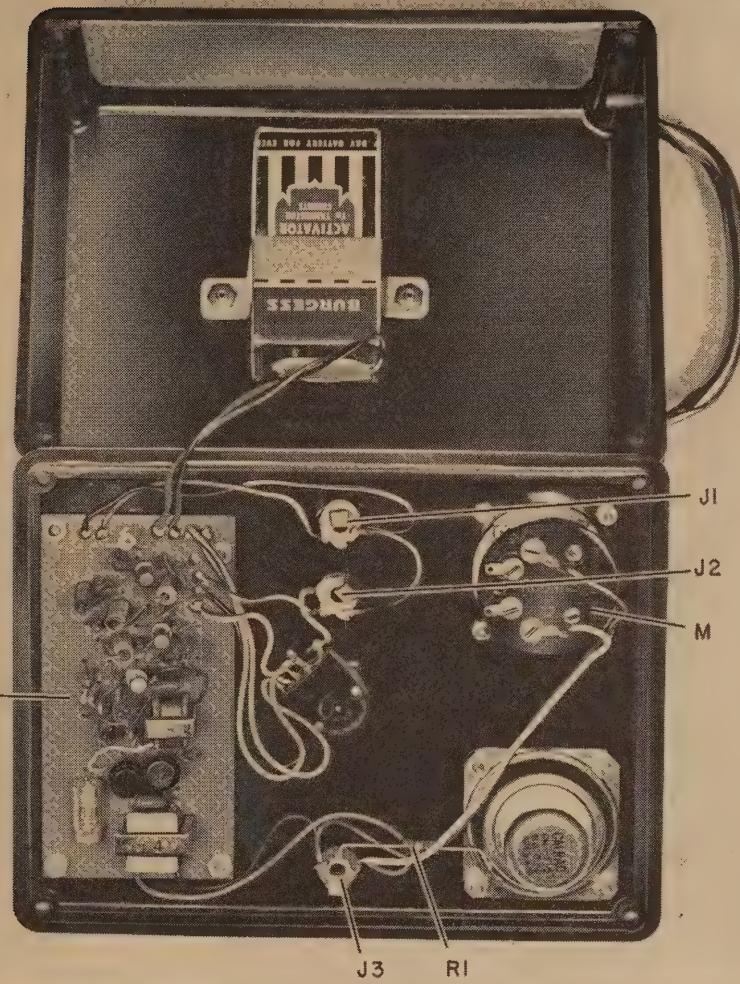


Fig. 2—Two input jacks offer choice of sensitivities: high gain at J1, low gain at J2. Input impedance at J1 is a few thousand ohms; at J2, approximately 10,000.



The wiring shouldn't take more than half an hour.

tin and two screws, or it can be attached with tape.

The VU meter is supplied with a separate resistor, which may be discarded. Connect to the meter terminals directly. Connections for the internal pilot light are not used. Input and output leads must be well separated to prevent the possibility of feedback and oscillation.

Examine the amplifier for loose blobs of solder and any parts that might be shorting because they were bent out of position by packing or shipping. A small piece of fine brass screen was used as a speaker grille to prevent accidental damage to the cone.

The "nose"

The input coil for hum exploration consists of a ferrite rod antenna coil mounted in a little plastic pillbox. Saw

Closeup of hum probe. Housing is clear plastic pill bottle. RCA type phono jack and plug make neat, removable connection that lets cable (shielded, of course) be used elsewhere.

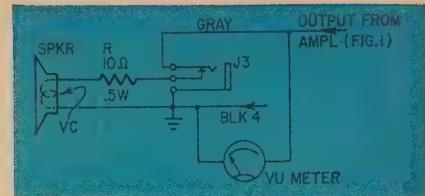


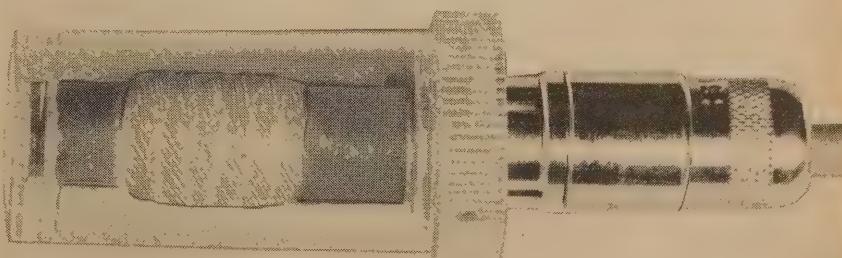
Fig. 3—Speaker and meter wiring. See text for details.

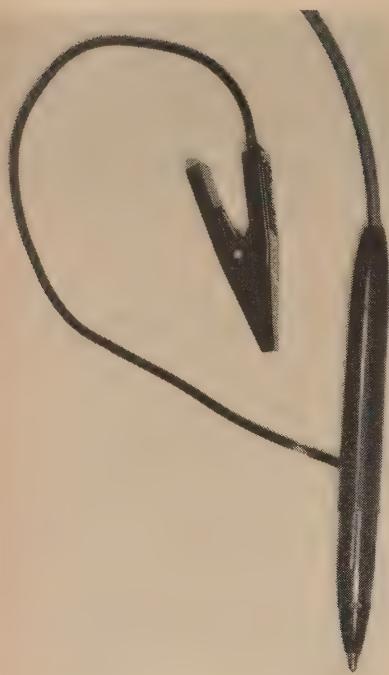
Bakelite case, $6\frac{3}{4} \times 5\frac{1}{4} \times 2\frac{1}{4}$ inches
 Bakelite panel to fit case
 Transistor amplifier, Lafayette model PK-544
 Volume control, 10,000 ohms with switch (Lafayette VC-2 or equivalent)
 1½-inch speaker (8 ohms) (Lafayette SK-61 or equivalent)
 VU meter (Lafayette TM-10 or equivalent)
 Miniature diode (1N34A, 1N60, etc.)
 10-ohm, ½-watt carbon resistor
 Miniature phone plugs (2) (Switchcraft 750 Tini-Plugs or equivalent)
 Ferri-Loopstick (Lafayette MS-299 or equivalent)
 Miniature phone jacks (3) (Switchcraft 42A Tini-Jax or equivalent)
 Microphone cable (single conductor plus shield)
 9-volt battery
 .001- μ F, 600-volt ceramic capacitor
 Discarded ballpoint pen
 Clip for ground connection from probe
 Miscellaneous wire and hardware

microphone cable) with a phono plug on one end and a miniature phone plug on the other to connect the hum coil to the amplifier (Fig. 4). You may prefer to solder the antenna-coil leads direct to the microphone cable and omit the extra phono plug and jack. This will be less work but does not make quite as neat a job.

The amplifier is also an excellent signal tracer. Construction details of a suitable diode input probe are shown in Fig. 5 and the photographs. I mounted the diode and capacitor (this isolating capacitor is necessary to keep high dc voltages from the amplifier's input capacitor) in a discarded ballpoint-pen shell. There is plenty of room if you use subminiature parts. The ballpoint of the pen was used as the probe. Cut off the ink cartridge about $\frac{1}{2}$ inch from the tip and solder the diode to it. (Quite a few of these ink cartridges are plastic. Discard the plastic part and solder the diode to the metal tip after cleaning out the ink.) A few drops of plastic cement will hold the pieces together after assembly.

The positive side of the diode should go toward the capacitor, as





Rf probe is built inside discarded ballpoint pen. Metal ballpoint is probe tip! See Fig. 5 for details.

shown in the diagram. Use 3 feet of microphone cable to couple the probe to the amplifier through a miniature Switchcraft phone plug.

Testing and using the Sniffer

Plug the hum-pickup coil into the first input jack (J1) and turn the volume control on full. Bring the hum coil close to a source of hum, such as a soldering iron. The meter should read full scale as the coil approaches the hum source. The speaker or a sensitive earphone plugged into J3 will give an indication with hum levels too low to give a meter reading.

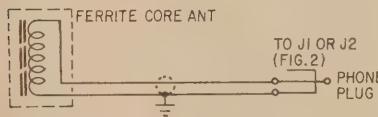


Fig. 4—Ferrite antenna, cut short and wired to tiny phone plug, is sensitive hum probe.

For most uses, you will be interested only in comparative indications of hum strength. The volume control may be set at a level that gives a good hum indication (satisfactory meter reading) when the probe is held in the 60-cycle ac field. As you take steps to reduce the hum (without moving the probe) you can gauge your success by watching the meter. Actual hum voltages are not important for such applications. The relative meter readings are what count. The ear is not reliable and cannot be depended on to judge relative hum levels.

The goal is zero hum, and lower

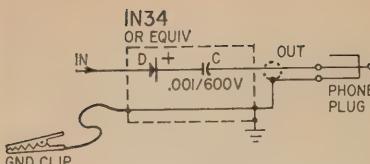


Fig. 5—Rf probe turns Sniffer into signal tracer.

meter readings indicate progress toward that goal with an accuracy not approached by merely listening.

If you wish, you can calibrate the meter with a particular microphone to indicate actual sound levels, or with a particular coil to measure actual hum field strengths. For that, you will need suitable known-accurate instruments.

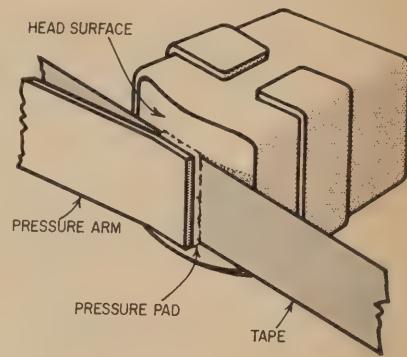
Other uses

The amplifier is also useful as a signal tracer. The diode probe may be plugged into either the first or second stage of the amplifier, depending on the amount of gain you need. The second stage input is useful primarily for checking high-output devices such as crystal phono pickups. A small microphone plugged into the first stage jack (J1) turns the amplifier into a useful listening device. This feature is also useful for checking microphones for defects. Use of the earphone avoids feedback from speaker to mike. However, this feedback can be employed to good advantage when checking microphones for gain.

A transistor amplifier is particularly useful for tracing a signal through such equipment as small portable tape recorders. Most transistor signal tracers lack gain. This Lafayette PK-544 amplifier is "hot" enough that performance is more like what you'd expect from a vacuum-tube signal tracer, and there are the advantages of quiet, hum-free operation, no line cords and no shock hazards while working on ac-dc transformerless equipment.

Tips on Tape Head Care

EVERY SERIOUS TAPE USER OUGHT TO give at least a passing thought now and then to the wear on his machine's recording and playback heads as the tape quite literally grinds past them. That smooth, satiny-looking iron oxide coating on the tape is actually used commercially (in a slightly different form) as an abrasive!



In a recent *Customer Engineering Bulletin* (CEB No. 3), Nortronics Co., Inc. (8101 W. 10th Ave., Minneapolis 27, Minn.), maker of tape recording heads and electronics, puts forth a few startling statistics on tape-head wear. The table here gives very approximate useful lifetimes for high-quality nickel-alloy heads (which, sadly, are rather soft), depending on the speed and the kind of tape pressure control used.

TAPE HEAD LIFE EXPECTANCY

Pressure Pads	Tape Lifters	1.875	3.75	7.5	Probable Head Life (Hours)
Yes	Yes			*	500-600
Yes	No			*	300-400
Yes	No		*		500-600
Yes	No	*			700-800
No	No			*	1,000-2,000
No	Yes			*	2,000-4,000

Life depends greatly on condition of tape, make of head and even ambient dust and humidity.



"I'd think with the two of you working on my set you could find out why it shows a double image."

You'll see at a glance that while pressure pads are a simple and effective way of keeping the tape in intimate contact with the heads, they're murderous to the critical head surfaces. This is true especially of pressure pads that press against only a small area of the head (see drawing) or ones that press with a force of more than about 1/2 ounce.

Not only does premium-quality tape from a reputable manufacturer save wear on heads, but *used* tape (in good condition) is less abrasive than new tape.

When you clean tape heads, never use stiff brushes, pipe cleaners or any tools that might scratch the highly polished surface. Use lens-cleaning tissue or cotton swabs.

A service shop owner finds himself working on tape recorders for the first time when his recorder man takes off for vacation

Six Days On Tape Recorders

BY ART MARGOLIS

A TWINGE OF APPREHENSION RAN through me momentarily as my benchman who repairs tape recorders smiled, "I leave on vacation tomorrow morning, Art."

It was Saturday night and I knew first thing Monday morning I was going to have to cover for Dick in addition to my other duties.

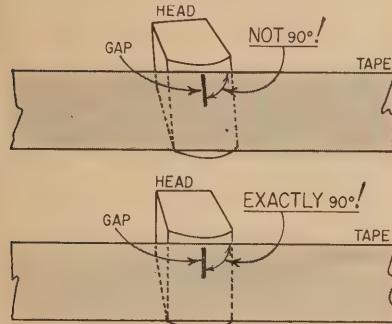
Funny thing, but in all my years of electronic service I haven't had much to do with tape recorders. The apprehension left as I figured, "Now's a good time to learn."

Monday morning first thing I was faced with a 10-year-old Pentron. I call this job the

Case of the distraught detective

Sergeant Salter of the local police force walked in the store with an unhappy look on his usually cheerful countenance. He lifted a large tape recorder onto the service counter.

"Art, this machine has real trouble."



If the head gap isn't perpendicular to the direction of tape travel, high-frequency reproduction will suffer. Unless, of course, you record and play tapes with the same misaligned head!

I plugged it in. He continued, "We caught this bird when he tried to get into a window at the delicatessen. He started singing as soon as I put hands on him."

I turned on the machine.

Salter went on, "I figured I'd get his warbling on tape. I never heard anything like it. So I recorded the canary on the battery-operated recorder I keep in the patrol car. I played it back and

it sounded perfect. Then I went over to the JP's office. This is his recorder."

I was getting a little annoyed at the melodramatic terminology of birds and singing. It wasn't like Salter. "So what happened when you tried to play the confession back for the JP?"

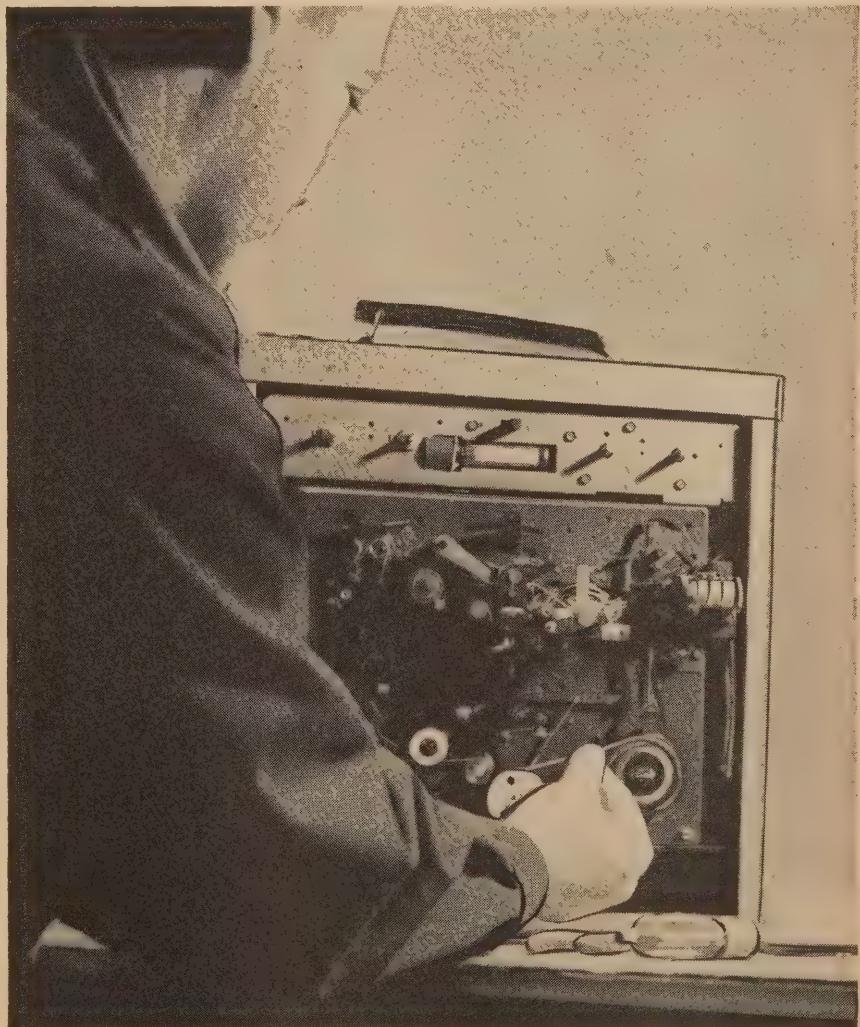
Salter looked blank at me but went on, "All we got out of the machine was a bunch of hissing throughout the entire recording. Also, when I tried to play back on my portable it didn't work any more either. I don't know whether I can get the canary to sing like that again and we probably ruined the tape."

I began playing the tape. Disjointed noises and hissing came out. It sounded like the commonest of all troubles.

I pulled out my pocket knife, which has a tiny compass in one end. I pulled the plug on the recorder and held the compass next to the record-playback head. The needle pointed at it. It was magnetized!

This one-way constant magnetism, when it's strong enough, brings up the hiss level and can even erase a tape passed through its field. This one was strong enough. No wonder Sergeant Salter was sick. I removed the tape.

Art Margolis installs a new drive belt on a tape recorder.



The remedy is easy and should be applied routinely after every 8 hours or so of recording. All tape heads gradually become magnetized from the surge of current through them whenever the machine is switched between record and play.

I brought out my tape-head demagnetizer. Any ac field will do the trick, even a solder-gun tip, but an electromagnet made for the job is best. I plugged it in and placed it on the head, held it there a moment then gradually drew it away before unplugging it. The head was demagnetized that easy.

"That's it," I told the Sergeant. He said, "Let's try to record the bird again, Art. He's out in the car." As he walked out, I thought, Now the shop is becoming an interrogation room. . . .

Salter came back in, carrying a round cage. I heard the bright clear chirping of a canary. Salter's broad features relaxed to a grin, "Listen to him, Art. He's going great."

Little Sir Echo

While hiss can be imprinted permanently on a priceless prerecorded tape by a magnetized head, other head troubles can also cause noise, though it may not be placed on the tape. John Mazzo, our local pizza king, brought such a job into the shop on Tuesday. I repaired it and he took it home.

However, he was back in an hour. He moaned, "Art, I lost my voice." He fancies himself something of an operatic tenor. Not bad, but not much volume.

He put his recorder back on the service counter and said sadly, "Listen to my voice I just recorded."

I plugged the machine in and turned it to playback. John's small tenor voice came crying out of the speaker. I was pleased with the reproduction.

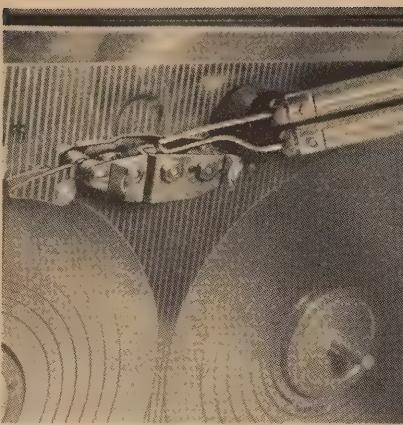
When he brought it in there had been a continuous hiss and crackling. This is a common trouble in tape recordings when routine maintenance is neglected.

As you play your recorder week after week, the tape rubs gently against the record-playback head—as it should. A minute deposit of tape residue is left on the head. It takes about 90 days of constant use for the residue to amount to anything, but gradually it does.

As the deposit accumulates, the background noise begins. The noise increases so gradually that the user is almost unaware of it until someone points it out to him.

John had originally brought his player in to get rid of the noise. On the counter I soaked a cotton swab in some medical alcohol. Then I gently swabbed down the soft metal head surface till it was perfectly clean.

Then I tried the recorder with a clean roll of tape. I recorded some "Test, one, two—" and played it back.



The ac field around a soldering-gun tip can demagnetize heads in a few seconds. Specialized head demagnetizers aren't expensive, though, and will be more convenient for frequent work.

The background noise was completely gone, but I sounded like I was in an echo chamber. I tapped the tubes. When I hit the 6SL7-GT audio amplifier there was a *ping!* I replaced the microphonic tube.

On my next try, the echo was gone. I stopped thinking about the repair and returned to listening to John's voice coming out of the recorder. "What's wrong?" I asked. "It sounds good to me."

"The depth and quality of my voice is gone," he moaned. "There is no more dimension to it."

Then it struck me. I rooted through the trash basket. There was the old microphonic 6SL7. I replaced it in the machine and told him to try recording again. He sang heartily in the front of the store. We played him back. A big smile broke out all over his little face. Back in the 6SL7 with the loose elements, his voice gained stature. He left

A cotton swab dipped in alcohol cleans heads of tape residue.



pleased as could be.

Besides those repairs that caused human complications I had several tape machines with mechanical trouble.

The mechanical side of a recorder—the tape drive assembly—includes the motor, drive belts, springs, wheels, brakes and clutches. It carries the tape from supply reel to takeup reel and keeps it in contact with the heads, or away from them during rewind.

Tape speed is controlled by the capstan and idler.

I had one machine that piled up all the tape at the supply reel. Lifting the deck, I found the drive belt broken. A new one cured all.

Another machine kept breaking the tape after a few feet of play. There seemed to be too much drag on the supply reel. It would stick just before the tape broke. A spring held the wheel too tight. I loosened it a bit. The tape stopped breaking.

Another machine played perfectly but moaned and groaned during operation. I began putting some lube in the bearings. When I touched the bearing on the motor with a single drop of oil, the noise stopped.

A large machine was stuck in playback. A long look at the mechanisms in the playback area revealed a spring hanging loose. It was meant to hook onto the lever that holds the recorder in playback. Rehooking the spring made the lever release the playback lever.

A stereo unit came in. One of the erase tracks didn't work. I changed that erase head and cured the trouble.

A large old recorder had a loud 60-cycle hum at all times on any new recordings. A ground strap between the chassis and the head assembly had come loose. I soldered it back on.

A Japanese player came in with the rewind-wind and play-record selectors not working. All that was wrong was loose setscrews in the knobs—not loose enough for the knobs to come off, but loose enough to let them slip.

My mechanical ability plus my TV experience carried me easily through all the repairs. Tricks like drawing a rough picture of any disassemblies I made kept me from goofing up the reassembly. Looking the machines' service data over carefully before picking up a screwdriver briefed me on the strange territory. A couple of jobs were time-consuming, but they weren't really dogs. Some jobs you'll cuss over. Those you must battle out for yourself. The tougher they are, the more experience you get out of them, though. Late Saturday evening I had the last call.

The Case of the Extravagant Audiophile

Tight-lipped Dr. Carew, who spares no expense on his large tape library, *continued on page 58*

by Jack Darr
Service Editor

Service clinic

This column is for your service problems—TV, radio, audio or general and industrial electronics. We answer all questions individually by mail, free of charge, and the more interesting ones will be printed here.

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down" pattern on alternate peaks. This is due to the very heavy pulse of current taken from the B-plus by the vertical output stage. It causes a drop in B-plus if the power supply regulation isn't too good. The poorer the regulation, the greater the difference between high and low peaks. The ripple is basically 120-cycle, and the vertical pulse is 60-cycle, hence the alternate peaks.

Now the fun starts. On a network show, there will inevitably be a small difference between the 60-cycle vertical sync and the local 60-cycle ac line frequency. There will be a very-low-frequency "beat" between the two! This beat will cause a bulge or bend to travel through the picture. The beat is large enough, it can even cause the edges of the raster to bend, or wave in and out.

Lock this pattern in on your scope as tightly as you can, and watch it closely. You'll see the very slow movement (right or left) of the beat frequency. The small pulse will move over and "crawl up" the big ones, with a resultant increase in amplitude. This is almost impossible to describe or to illustrate in a stationary drawing, but you'll see it immediately if you watch that scope screen for a second or two!

This kind of trouble shows up in two kinds of TV chassis: cheap ones, and good ones with old filter capacitors. The basic cause is insufficient filtering, causing poor regulation in the B-plus supply. In one notable case, which I think we've mentioned before, a bend traveled through the picture. As it reached the top, the picture lost sync and rolled. When the bend had gone on, the picture locked again, the bend appeared at the bottom of the raster and started all over again. "Scoping" the vertical sync revealed at least a 60% drop in amplitude as the bend reached the top of the screen! Dc plate voltages, as seen on a vtv, didn't drop, but apparently the ripple, when both pulses came in phase, was so heavy that it was causing a loss of plate voltage in sync with the sync! The sync was, in effect "punched out" by this loss of plate volt-

THOSE ODD BENDS IN A TV PICTURE CAN be very puzzling. The cause is usually simple, once we find it. One annoying version is the "weave"—a bend that travels through the picture from top to bottom, or perhaps from bottom to top. This shows up as a horizontal kink or buckle in vertical objects (doors, poles, etc.). Network programs are the main sufferers.

Check B-plus ripple with your scope, using a direct probe. If ripple is a bit higher than the schematic calls for, look out. The standard pattern here is like Fig. 1. Note the "one up and one

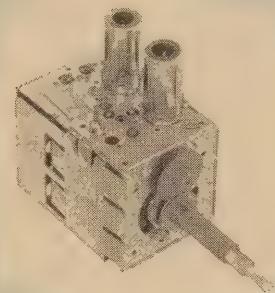


Fig. 1—B-plus ripple pattern in many TV sets, taken at filter output. Ripple is usually 120 cycles; vertical output stage draws heavy current every 60. Hence the shortening of alternate peaks.

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age, and the picture rolled until the bend had advanced far enough in its phase relationship to the ripple!

The cure in this case was to add more filtering, since the set design was not of the best. A 100- μ f electrolytic on the B-plus line cured the trouble.

A very similar trouble, without the loss of sync, showed up in an old Philco, vintage 1950. No hum bars or any of the classic symptoms of ripple showed up, but we did have a bothersome bend that traveled through the picture. Replacing three filter electrolytics, all "just a little off," cured the trouble. Maxim: suspect any electrolytic capacitor that is more than five years old. Just like kids, this is about the age when they begin to get into trouble!

So, if you have oddball symptoms like this, and the basic symptom seems to be related to a 60-cycle fundamental frequency, *look out for bad filtering*. Unusual ripple waveforms and, above all, any motion of a "phase component" in the ripple waveforms are the clues. High power factor in electrolytics reduces filtering efficiency, and every now and then you'll find one that won't show any apparent improvement when it is bridged by a good one. Take it out of the circuit and test it thoroughly, or replace it temporarily.

Acoustical problem

A local theater has a serious acoustics problem. Music sounds fair, but speech intelligibility is awful. The reverberation time of the auditorium is nearly 3 seconds. The budget doesn't allow massive acoustical treatment. Is there anything I can do to the amplifier to compensate for this long reverb time?

H. D., Cuero, Tex.

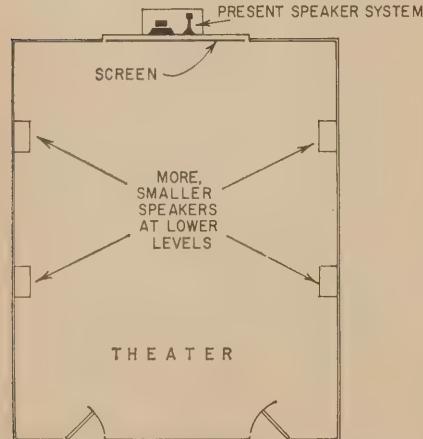


Fig. 2—More speakers, operating at lower levels, help kill excessive reverberation. Point speakers downward into audience.

I'm afraid not! Your trouble, as you found, is the reverberation time of

the hard-walled auditorium, and not in the amplifier's response. About the only thing you can do is cut the highs: this will reduce the feedback and bounces, but only by a very small amount.

Best cure would be to redistribute the speakers. Using the present single-source system, you must use a high volume. This *causes* bounces from those hard walls. By using as *many* (smaller) speakers as possible, spread along the walls, you can hold the maximum sound output from each one at a low level. Fig. 2 shows how this would look. By "drizzling" the sound over the audience, you can avoid the bounce from the walls. Sound-column speakers would also be very useful here. Take a look at the article "Column Speakers Solve PA Problems," *RADIO-ELECTRONICS*, May 1964, page 28.

Ion-burns in rebuilt tubes

A Sylvania 620BU keeps burning the phosphor screens of two rebuilt 21AUP4 tubes. The original 21AVP4 was gassy, and I replaced it with an economy rebuilt 21AUP4. In 5 months, a small, dark, purplish "ion-burnlike" spot appeared near the center of the screen and kept getting bigger. About 5 weeks later, I replaced the picture tube with another rebuilt 21AUP4. Three weeks later this tube started spotting, but with smaller spots all over the screen.

What is causing this?—M. B., DeQueen, Ark.

Inasmuch as you didn't give the make of rebuilt tube you used, about the only answer here is that the tubes were defective. The only cause for ion-burning in good tubes is an improperly adjusted ion trap. This is about the normal time limit for ion-burning, too; it usually takes from 3 to 5 months for a severe ion burn to show up.

If these tubes were "factoryrebuilt" from one of the larger manufacturers, take this up with the distributor who sold them to you. However, if they were rebuilt by a small firm, I don't know. I have used a great number of "factoryrebuilt" such as RCA's Monogram line and other similar tubes, and had very good results with them. Some of the smaller rebuilders may be using the old screens, or you may have been the victim of an unethical type who merely "shoots" the tubes, rebrands them and sells them for new. In this case, it is probably just too bad! From the symptoms you have given, this sounds very likely!

The best way to avoid this trouble is to use a good brand of tube. There are plenty of them, and they carry a full warranty. It is false economy to patronize "back-alley" tube rebuilders. END

continued from page 56

called for tape recorder service in his home. I arrived with my tape service kit under my arm.

"Got a strange one this time, Art. Otherwise, as you know, I'd have fixed it myself." I had to admit grudgingly that he probably would have, too.

"Some of my tapes sound perfect and others sound like they're covered up with a blanket. How do we start?" He opened my tool box and began laying out my tools on his table top.

I began by asking, "Which tapes are which? Make two piles. One of the good ones and one of the muffled ones."

He smiled. "Way ahead of you." He pointed to the two piles on the coffee table. "The left pile is the goodies, the right is the baddies."

I began looking through the left pile. All had one thing in common: they were all homemade by Doc. I rifled through the right pile. They had a common characteristic too. They were all commercial prerecorded tapes.

"Well?" he asked.

"Doc, the bad ones are from many commercial tape machines. The good ones are all from your tape recorder. This indicates that something is wrong with your tape recorder."

"I don't follow, Art."

I went on, "Evidently your machine is recording out of alignment and then playing back on the same head. So your home recordings will sound OK since they are played back in the *same* out-of-alignment condition."

His eyes brightened. "Pretty sharp. Then my machine is set for my recordings but none other. Especially those commercial jobs recorded in perfect alignment. How can we fix that?"

"By realigning your tape heads till they are perfectly perpendicular to the tape. It's done like this."

"I connect a vtvm to your recorder output and set it on an ac scale. Then I play this audio alignment tape, which is nothing but different-frequency tones—5 kc., 10 kc. and such. We adjust the head with this setscrew till we get the highest ac voltage reading for all notes. At that point the head is perpendicular to the tape. Shall we start?"

"Don't you dare touch that screw, Art. It'll make all my own tapes muffled then, won't it?"

"Probably."

"Then leave it misaligned. I've spent months getting those tapes prepared. I'll get a new tape recorder for the commercial tapes."

Dick arrived back on Monday morning. "How'd it go, Art?" he asked.

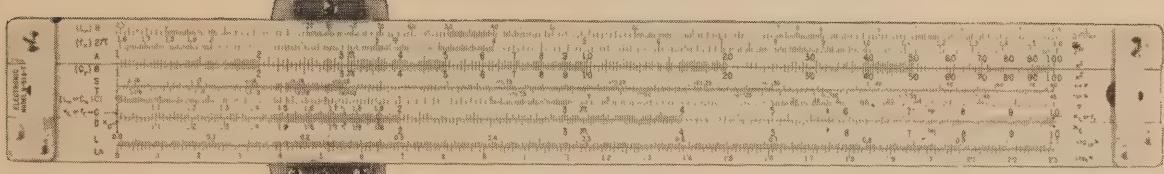
"The machines weren't too bad, but the people!"

He laughed. "Yep, they're nuttier than TV customers!"

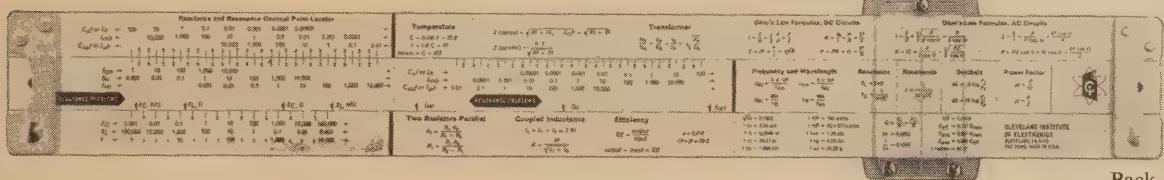
I smiled and was happy that I wasn't alone in thinking that. END

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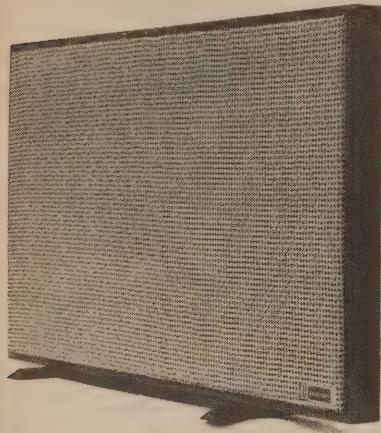
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AUDIO EQUIPMENT REPORTS

University Tri-Planar Speaker System

ULTIMATELY, I AUDITIONED TWO OF these in stereo, but I started the evaluation in a more modest way. This has a bearing on my findings, as you shall see. The first arrived and, having a stereo system, I stood the new speaker on a coffee table in front of one of my stereo speakers and tried "A-B"-ing it on that channel, with the other channel unchanged. This was a surprisingly agree-



Components: Two, 9 x 12-inch flat rectangular diaphragms, made of thin sheets of specially selected wood. Separate cone tweeter. Both radiators operate together at low frequencies to reduce bass distortion. One radiator produces bass only, the other, bass plus mid-range.

Frequency response: 45-18,000 cycles
Network: 6 db/octave
Power rating: 20 watts integrated program material
Impedance: 4-8 ohms
Dimensions: 23 in. wide x 15 in. high x 1 3/4 in. deep
Weight: 9 lb.
Price: \$53.50

able experience, considering that the installed units were much more expensive.

I compared the single Tri-Planar with other units in a similar way and concluded that this speaker gave as smooth a response as many costing much more, although bass was definitely *different*. Next I tried putting the Tri-Planar in the position normally occupied by the regular stereo speaker and it didn't confirm my first expectations. However, with a "good" speaker on the other side, I felt it would provide quite a good overall stereo effect. After all, there was a very considerable space saving . . . That alone would justify this novel speaker. But don't go away.

All this testing with one Tri-Planar was not according to plan. I was supposed to have two, to evaluate on stereo, but somebody goofed in the shipping department and only one was sent. Eventually the second arrived, and the two were tried on stereo.

First I replaced my own two stereo speakers exactly, putting the new ones as flat against the wall as they would go (their feet keep them at least a couple of inches away) and about 8 feet apart. The sound was awful. No bass whatever, and coloration we didn't like at all. But I couldn't forget that first favorable reaction. So I pulled the units out from the wall 8 or 10 inches. A little better, but not at all what I expected.

I reread the instruction sheet. Apparently I had done pretty much what the manufacturer intended. The sheet recommends 6 to 8 feet spacing between them and suggests experimenting to find the best placement. This I visualized as meaning different places, more or less against the wall, and always about 6 to 8 feet apart.

The one unit had sounded good on a coffee table. But few people want speakers on coffee tables almost in the middle of the room, so to speak, so I tried placing them on convenient pieces of furniture at the sides of the room—the rather large TV console at one side and the hi-fi cabinet on the other. This put the Tri-Planars at a width of about 15 feet, about 30 inches from one end wall and against the longer walls, which are about 20 feet (see sketch).

This was not the same speaker system at all! Now the effect was superb. All the bass you could want, but without any boominess, and the middles and highs clean and smooth. The most extraordinary thing, though, is the way it *covered* the room with stereo. Even standing level with the units, and much nearer to one than the other, the stereo effect was still sharp and clear. In fact, getting this close, I lost the sense that sound was coming from two boardlike units; it seemed to be originating from a phantom orchestra, spread across the room.

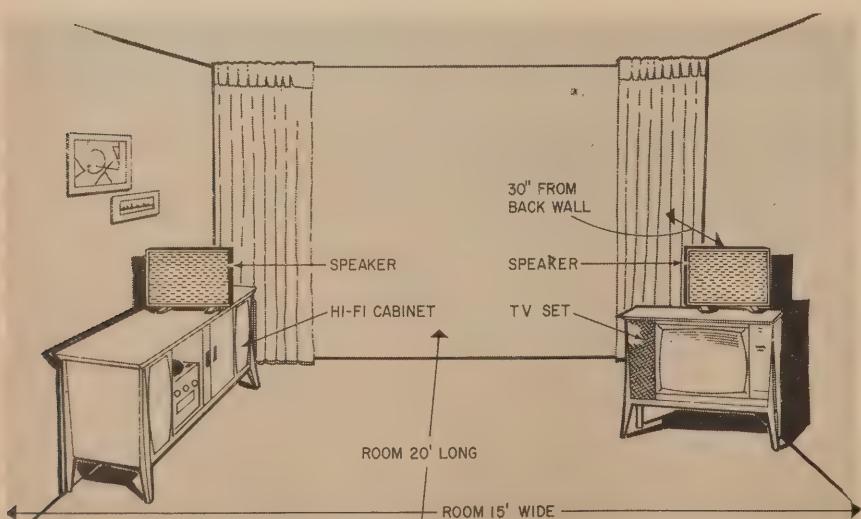
Only after I tried this did I remember a paper given some years ago by CBS Labs, about a system they called the "isophonic". This was one of those deals where the bass was combined in a single woofer, which could be hidden under the sofa or anywhere you liked, while the middles and highs were fed to the isophonic units, which were small baffles with cone type units and the backs left open so they acted as dipoles.

The Tri-Planars placed in this way were doing almost the same thing, except that the whole frequency range was being handled in isophonic. The effect is something new in stereo listening. The speakers "let go" of the sound. It is no longer tied to them. The sound, particularly transient sources like a piano, is heard with extraordinary transparency, but it does not come "through" the 15-by-23-inch "hole" represented by the boardlike area of the speaker. It fills the room with real, live stereo.

On a "squeak" test, with an audio oscillator, I found that, free and clear rather than against a wall, the units really have as smooth a response as they seem to have with music. They are not insensitive. Though not as efficient as some speakers, they are much more sensitive than most of the bookshelf variety. Two 20-watt amplifiers are plenty to fill even a good-sized room with stereo sound, without pushing at all hard.

Many readers don't have handy pieces of furniture at least 23 inches from front to back on which to stand their speakers, so I tried putting the units vertically, which makes them only 15 inches wide. The foot, which comes separate in the package, can be fitted to

continued on page 67





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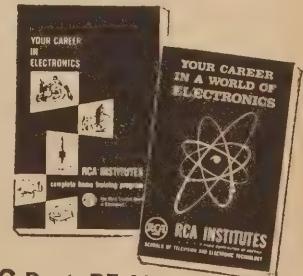
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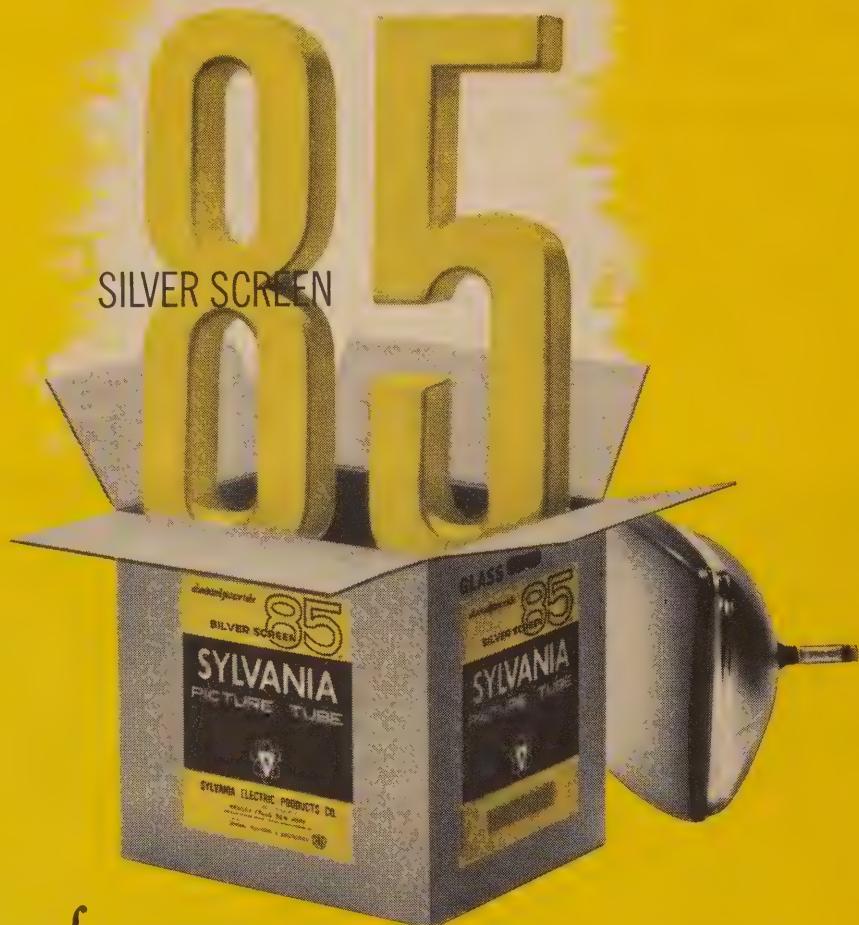
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either a long or short side. The long way was very slightly better—I had to listen hard to tell any difference. On a narrow piece of furniture the vertical way would probably sound better, as well as being infinitely more convenient.

I had some hi-fi friends give these a try, too. One said the bass was not as good as from his big bass reflex. But his wife, who objects to "screeching highs", disagreed with him and thought they were wonderful. Everyone was impressed by the realism of stereo using the edge-on placement.

Really, not being able to set them flat to the wall is not such a serious disadvantage as you might think. We are creatures of habit. That's the way we've always put speakers. But these are the start of something new. For example, they can be included in one of the modern, open type room dividers, quite readily and unobtrusively. Or, placed vertically on any suitable slim piece of furniture, they will project an effective stereo pattern. Once the idea of this edge-on placement is understood, ingenuity will find endless ways of doing it. And from my observation, it's worth every bit of effort, for the realism to be enjoyed.—*Norman Crowhurst*

Stradford Hi-Fi-TV Adaptor Model 480



MANY HI-FI ENTHUSIASTS WOULD LIKE to hear TV sound through their hi-fi systems, rather than through the small speakers and low-powered circuits of their sets. The Stradford 480 "Hi-Fi-TV Adaptor" (made by Trutone Electronics, Inc., 14660 Raymer St., Van Nuys, Calif.) makes this about as easy as possible. This is one of those things that we see, then say, "By golly, that's cute! Why didn't I think of that?"

The sound is picked up in the form of a 4.5-mc sound i.f. signal, fed to a hi-fi ratio detector and then through a cathode-follower output into the hi-fi system. Installation is so simple that the conventional 10-year-old kid could do it, if he could find the sound detector tube on the set's tube-layout chart.

A floating tube shield is placed over TV's sound detector tube. It must not ground to the chassis. A single wire connects this to the input of a two-stage 4.5-mc amplifier-limiter, with two 6HS6 tubes. The diodes of a 6BN8 are used in a full-bandwidth ratio detector, and the triode section is the cathode follower. Up to 25 feet of standard hi-fi connect-

ing cable may be used without loss of quality. Standard phono plugs are used on the adapter.

No adjustment is needed; when I hooked it up, it worked immediately. The only "controls" are a slide switch and a pilot light on the panel. The only precaution needed is to use a low-gain input on the hi-fi amplifier. The output of the 480 is about 2-3 volts of audio, and this will very likely overload a high-gain input. Use the "ceramic cartridge" or "auxiliary" input, or their equivalents.

Another handy feature of this system: any program may be recorded while it is being viewed, by connecting the 480 and feeding its output into a tape recorder. This might be useful in educational-TV or commercial installations.

This unit has a power transformer and a silicon rectifier. The cabinet, finished in gold, measures only 2 1/4 x 9 1/2 x 6 inches deep. The 4.5-mc wire and one shielded audio cable are furnished. If you have interference, use coax for the 4.5-mc connection. The only possibility of trouble I can see is "beat interference" from signals radiated from the detector, and this did not show up at all during our tests, on a color TV set (one prone to odd beat interference, I might add!). Most of this comes from the video detector, but if you have trouble, you could use an auxiliary shield, and make the rf pickup with a strip of foil between two pieces of tape inside the shield.

The Stradford Adaptor has one other decided advantage, if you happen to have your hi-fi set, as mine is, near your favorite chair: it lets you turn off the sound on obnoxious TV commercials without getting up!

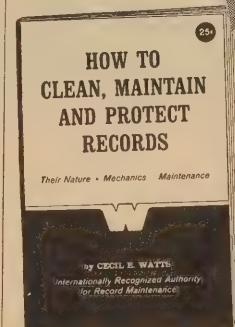
END



My husband says he doesn't want the set to leave the house.

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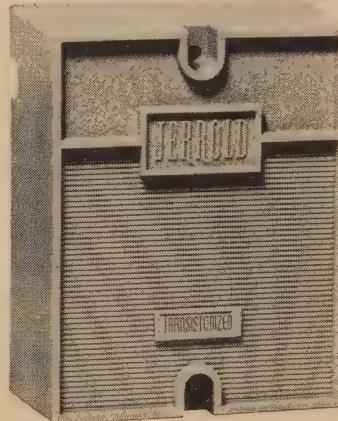
Ask your Jerrold distributor for complete information, or write *Jerrold Electronics, Distributor Sales Division, Philadelphia, Pa. 19132.*

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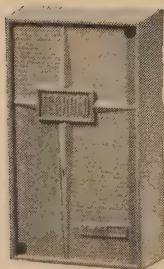
INDOOR POWERMATES

NEW!

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Model TA-24 List price \$24.95



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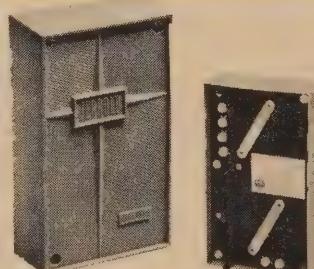


NEW!

For two-set (VHF) indoor coupling in suburban to fringe areas—new Indoor Powermate Special supplies two VHF TV sets or a TV and an FM set from a single antenna.

Model TA-12

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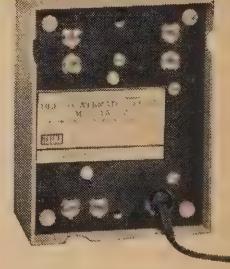


NEW!

For FM stereo indoor amplification—new Stereo Range Extender is the Indoor Powermate for the FM band. Extends FM broadcast range and splits FM from TV signals to permit use of single broadband TV antenna for both.

Model SRX

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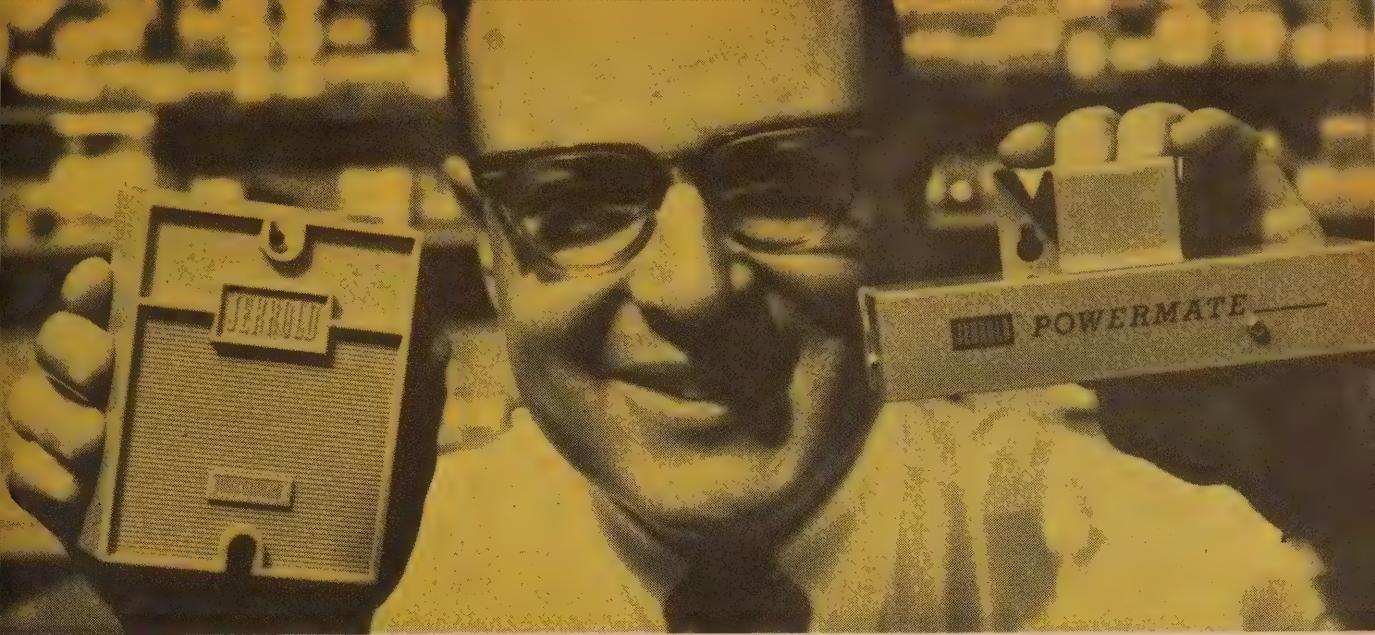


NEW!

For UHF set coupling indoors—new UHF Indoor Powermate Special supplies clean signals to two UHF sets from a single UHF antenna. High isolation between outputs minimizes interference between sets.

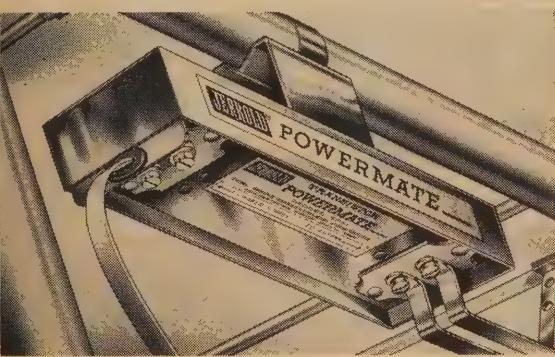
Model TAU-12

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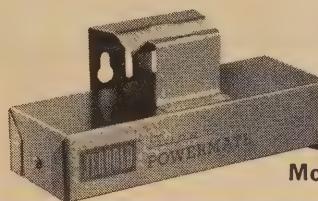
OUTDOOR POWERMATES



For snow-free VHF TV and noise-free FM where overload is no problem—the original Powermate has been improved with new power-supply circuitry. Unparalleled gain throughout hi and lo VHF bands, coupled with exceptionally low noise figure. Dual outputs.

Model APM-102

List price \$39.95



For bringing in weak VHF signals without overloading from strong local signals—the famous twin-transistor Super Powermate introduced last year. Exceptional gain-overload capabilities permit it to deliver signals from far-distant stations bright and clear, without overloading from strong signals "in your back yard."

Model SPM-102 List price \$44.95



For best color and b&w reception in weak-signal areas—new Super Powermate Coaxial is the coax-download version of the famous twin-transistor Super Powermate Model SPM-102 described above. Coax download assures superb color and b&w reception by prevention of interference from auto generators and other transients...also is not affected by corrosion and bad weather.

List price \$47.95



For low-cost VHF TV and FM reception in no-overload areas—the new Powermate Special delivers plenty of crisp, bright pictures and sound throughout the VHF and FM band—even from distant stations.

Model LPM-102

List price \$29.95



For deepest fringe areas—Transistor successor to the famous "De-Snower" model DSA-132, this is the mightiest Powermate of them all. Works where all other units fail. Ideal for small public buildings as well as homes. Coax download assures excellent impedance match and minimum interference pick-up. Available October.

List price \$97.75



Model UPM-104

For UHF reception in fringe to deep-fringe areas—new super-gain antenna-mounting UHF Powermate. Twin transistors bring in excellent clear pictures even in the most difficult UHF reception areas.

List price \$49.95



For low-cost UHF antenna preamplification—antenna-mounting UHF Powermate Special with single transistor provides enough gain to bring poor UHF signals in out of the snow.

Model ULP-104

List price \$34.95

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test equipment report

Precise "Power-Lab" Models 711-713

ALL ACTIVE ELECTRONIC DEVICES HAVE one thing in common—a source of power. But there is nothing common about what kind of input power they require. Some need line voltage (117 volts ac); transistors are often worked on dc voltages as low as 1.5 and sometimes higher than 24. It can take a load of equipment to supply just the more frequently encountered voltages—unless you use a piece of equipment like the Precise 711 or 713 Power-Lab. (Precise Electronics & Development Corp., subsidiary of Designatronics, Inc., Minoa, N.Y.)

The two models are practically identical. The difference is that the 713 has ac powerline isolation—a safety feature that is always recommended. It can be switched out of the circuit when a continuous load between 300 and 1,000 watts is being tested. (For about 60 seconds maximum, the rating may be doubled.) Isolation can be used for any load up to 300 watts.

The high-voltage ac can be varied from 90 to 140 volts—with or without the safety benefits of isolation.

Switching in rectifiers makes the unit a substitute for any 750-ma power supply between 140 and 200 volts dc.

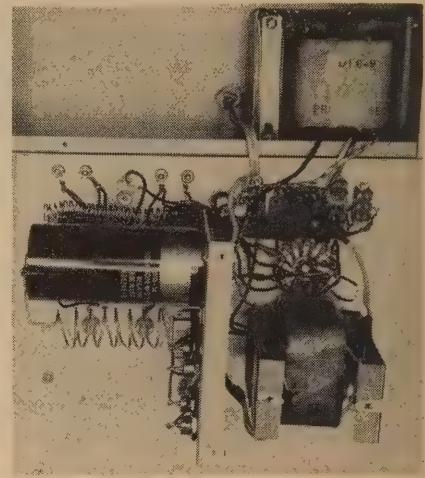


The filtering in the high-voltage dc output of the PowerLab is sufficient for practically all circuits. The ripple, at 50 ma, is low.

The low-voltage dc circuitry can supply up to 10 amperes continuously for testing automobile radios at 6 or 12 volts. (Up to 20 amps for 60 seconds.) The voltage is variable from 2 to 30 volts in two ranges. The dc ripple is 0.3% at 1 ampere.

Variable low-voltage ac is also available. The output is adjustable from 2 to 24 volts ac with currents as high as 10 amperes.

Five-way binding posts are used for both the ac and dc low-voltage outputs. The high-voltage ac and dc outputs are through female receptacles



Front panel of Precise model 713 dropped down to show wiring. Everything except isolation transformer is on panel. Coils are manganin-resistance wire and carry high currents.

that accept the standard male power-line plug.

A 5-inch panel meter is used to measure voltage and current on the various ranges selected by the switches. Voltage only is metered on the low-voltage ac and high-voltage dc outputs.

The major functions of the PowerLab replace common bench equipment such as the battery eliminator, battery charger, bias box, isolation transformer and line-adjusting transformer—all this in one easy-to-handle cabinet 8½ inches high, 12 inches across the panel and 5½ inches deep.

Whether you buy the instrument prewired or in kit form, you end up with 25 pounds of power-packed utility that will find many applications on the experimenter's or technician's work-bench. The 711 (unisolated) costs \$74.95 wired, \$59.95 kit. The 713 is \$89.95 wired, \$69.95 as a kit.

Don't pass up the isolation feature—the life you save may be your own.—
Elmer C. Carlson

CORRECTION

In "Ten to the Many," by Jerry L. Ogdin (August, page 88), the figure repeatedly given as the answer to the example calculation (5.57×10^{-6}) is wrong.

The correct answer is 5.066 $\times 10^{-6}$ henry. Our thanks to Mr. Lloyd D. Strohl of Tuscalo, Ill., for pointing out this embarrassing fluff!



RCA OUTDOOR ANTENNAS

the name...the features...the line that sells

Now you can select the best model for your customer's location from this new RCA outdoor antenna line that combines all-channel yagi and multiple cross-driven types. Satisfy them with the sharpest color and black-and-white pictures.

Explain the RCA *exclusive* feature in customer language. Only RCA antennas feed energy directly into the transmission line from low band driven elements. These are capacitively coupled, positioned directly above high band driven elements. RCA, of course, phases low and high band directors for best high band performance.

A. RCA 500 FM antenna. Eight-element yagi. Acute directivity. 88 to 108 MC. VSWR 1.25:1. Average eight db gain.

B. RCA 400 antenna. 19 elements, for fringe area or distant reception.

C. RCA 200 antenna. 11 elements, for local reception.

D. RCA 300 antenna. 13 elements, for suburban and near fringe area locations.



CAPACITIVELY COUPLED

In addition, RCA's electro-lens director system absorbs maximum incoming signal power, gives extremely high gain across the VHF band, offers excellent forward gain on the front end.

More customer interest! A gold anodized finish protects every RCA antenna from weather corrosion. Wrap-around mast clamp aligns antenna on mast, prevents boom crushing.

Just call your RCA Victor distributor. Look at and learn about RCA 200, 300, 400 antennas...from the color TV pioneer! From there on...sell!

RCA PARTS AND ACCESSORIES, CAMDEN, N.J.

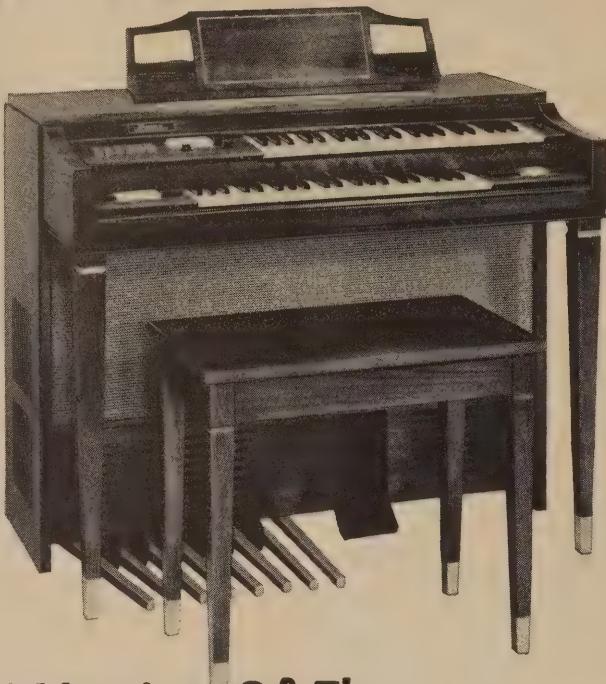


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Each and every component in the GD-983 is a genuine Thomas factory-fabricated part. And its advanced all-transistor circuitry means less heat, better tone, longer life, and virtually trouble-free performance.

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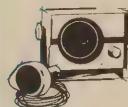
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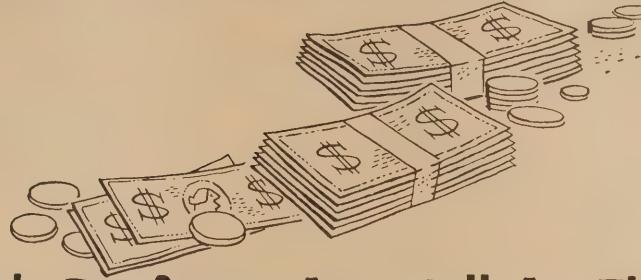
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See the special articles on the Heathkit GR-53A in the May issue of *Popular Electronics*, June issue of *Radio-TV Experimenter*, February issue of *Popular Mechanics*, April issue of *Science & Mechanics*, and the August issue of *Radio-Electronics*!

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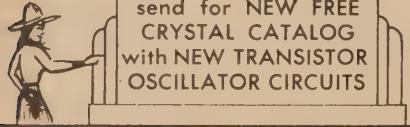
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New Semiconductors and Tubes

Novel novars— necessary nuisance?

Until now, novar tubes looked just like overgrown 9-pin miniature tubes. There were nine pins on the bottom, a little fatter than the miniatures' pins, and the envelope was just a little wider and taller. There was the familiar little nipple on top where a big machine sucked out the air and melted the glass closed around the hole.

Now, announces RCA, we shall have novar tubes with bottom exhausts—down among the base pins. Just like a compactron!

The purpose of the change, according to RCA, is to "permit the design of new equipment having greater compactness." Clearly, the new novars are shorter by the height of the old top nipple—about $\frac{3}{8}$ inch. The company stresses that the new types are completely interchangeable with the older novars. But we can't help feeling a paranoid twinge that somebody is just trying to confuse us further! (We already have things like a 13PDQ8, a 14PDQ8, a 15-PDQ8. . . !)

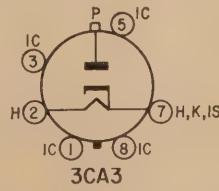
Wasn't it nice when, in a blush of optimism in the 1930's, the industry agreed to start standardizing on a new base with eight equally spaced pins around a thick black post with a key between pins 1 and 8? The 4-pin, 5-pin, 6-pin, little 7-pin, bigger 7-pin and big 7-pin bases were expected to drift into obscurity. And so they did.

But now we have little tubes with 7 pins, little tubes with 9 pins, big tubes with 9 pins and a stem on top, big tubes with 9 pins and no stem on top, medium sized tubes with 10 pins (see "New Semiconductors and tubes," August issue), squat little tubes with 12 pins and a nipple on the bottom. And some of them have top-cap connections, and some don't.

Who's keeping score?

3CA3

This TV high-voltage rectifier features a 30,000-volt peak-inverse rating (which the older 3A3 offers also), but

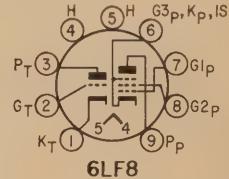


combines that with a 100-ma peak plate current rating—higher than any tube of its kind till now. Average plate current

is 2 ma, so the tube should hold up well in color TV circuits. The 3CA3 has an octal base, and its heater is rated at 3.6 volts, 225 ma. RCA is the designer.

6LF8

Another in a growing number of tubes developed especially for specialized color TV circuits, the 6LF8 is a high- μ triode/sharp-cutoff pentode combination, with a triode designed for operation with positive grid bias. That



makes it useful for certain kinds of color TV video amplifier stages. When the triode is operated with a grid bias of +3 volts, its amplification factor is 40. The maximum grid ratings are 4 volts and 8 ma.

The pentode section features a controlled "knee" in its characteristic curve, intended to give linear amplification even at low plate voltages (around 75 or so). Its transconductance is high: 11,000 μ mhos, which makes it a good video output stage.

MCR1304 series SCR's

A new series of 8-ampere silicon controlled rectifiers nearly 50% smaller than others currently available for that current rating has been announced by Motorola. Prices range approximately between \$2 and \$6. The units are la-



beled with suffix numbers 1 through 6 to indicate voltage ratings from 25 to 400. Designed to operate within a junction temperature range of -40 to $+100^\circ\text{C}$, they are housed in a newly developed steel case less than $\frac{3}{8}$ inch in diameter by just over $\frac{1}{4}$ inch high.

Low-noise, low-cost audio transistors

Four new silicon n-p-n planar transistors, designed especially for low-level audio use in home-entertainment equipment, were announced recently by RCA. They do not as yet have EIA "2N-" numbers, but are numbered serially under RCA's system.

The best of the lot, the 40233, has, in the words of Mr. D. P. Heacock, manager of market planning for RCA's Consumer Semiconductor Department, "exceptional low-noise and low-leakage characteristics for critical preamplifier circuit designs. . . ."

All four have a maximum collector current rating of 100 ma, a collector-to-emitter breakdown voltage of 18, a gain-bandwidth product of 60 mc.

Small-signal ac current gain of the 40231 and 40234 is 80, typically. The 40232 and 40233 have gains of 175 typically. The 40233 has a noise figure of only 2 db at 10 kc. That suggests that it might be possible to design a single-transistor emitter follower with a 1.5-megohm or higher input impedance.

Further information and technical details are available in the "RCA-40231, 40232, 40233 and 40234 Technical Bulletin," available from Commercial Engineering, RCA Electronic Components & Devices, Harrison, N.J.

Vhf-uhf cathode ray tubes

These tubes can be used to monitor rf output, modulation, etc., directly, without demodulation. One type, the D13-23, for uhf, can be tuned from 300 to 900 mc. The other, for vhf, can display signals from 0 to 250 mc.

To display signals directly at these high frequencies, the new tubes from

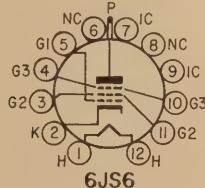


Amperex use a number of short deflection plates to decrease transit time and to make it possible to use the tubes in distributed lines or low-capacitance tuned circuits.

Both types are electrostatically focused and deflected, have 5-inch flat faces and use helical post-deflection acceleration systems.

6JS6

The variety of hobbies is almost unlimited. Looks like tube designers have come up with a new spare-time obsession recently: designing TV horizontal output tubes. The 6JS6, just announced by General Electric, is another in a staggeringly long line of big sweep bottles.



It has a plate dissipation of 28 watts and can stand 7,500 volts peak from plate to cathode. Peak cathode current is 1.1 amperes. The beam plates (labeled G3 on the base diagram) are brought out to independent pin connections so that the designer can bias them positive and eliminate uhf "snivets".

The 6JS6 is a compactron with a 6.3-volt, 2.25-ampere heater. Its construction makes it possible to operate it in any position. Looks like it might be just the bottle for the final in a low-power ham rig. Wonder how a pair of these would work in a SSB linear? END

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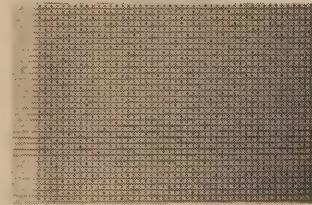
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TELEVISIONING THE MOON

continued from page 31

springs on our robot capsules, now advocated by many designers, we could use large—20- to 30-foot—sturdy polystyrene or other plastic balloonlike spheres, equipped with retrorockets. On the airless moon they could not of course float. They would be automatically gas-inflated before landing, hence would settle slowly with little shock that might damage the multiplicity of the capsule's delicate instruments.

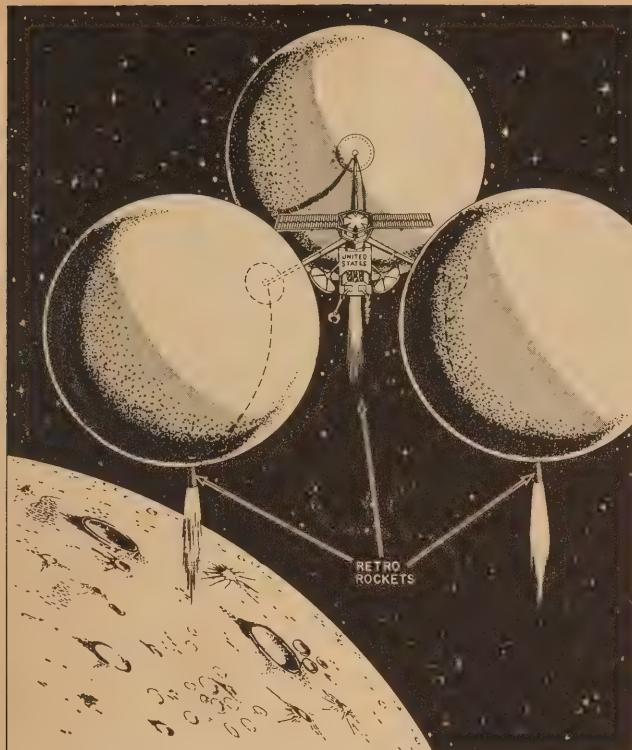
—H.G.



These six television cameras were used to take the lunar photographs. The two middle ones (top and bottom) transmit at the rate of one full-scan picture every 2.5 seconds. The four outer ones are 12 times faster and send back one partial-scan (and therefore smaller) picture every 0.2 second. Together with their supporting transmitter system, they were designed and built for the Ranger probe by RCA for the National Aeronautics and Space Administration. (RCA photo)



Last photograph taken by Ranger VII before it struck the Moon. Only part of a picture was taken when the camera was destroyed—the pattern at the bottom is receiver noise. Picture was taken 1,000 feet above the Moon's surface and covers an area about 100 x 60 feet. The smallest craters that appear in the photograph are about 3 feet in diameter and 1 foot deep. Picture was taken at 6:25 a.m., Pacific Daylight Saving Time, July 31. (NASA photo)



A diagrammatic rough sketch of a number of strong polyethylene or other plastic balloon-like bodies to enable a special instrumented unmanned soft landing on the moon. The central body carries, in a special metal case, all instruments to investigate the moon physically.

continued on page 80

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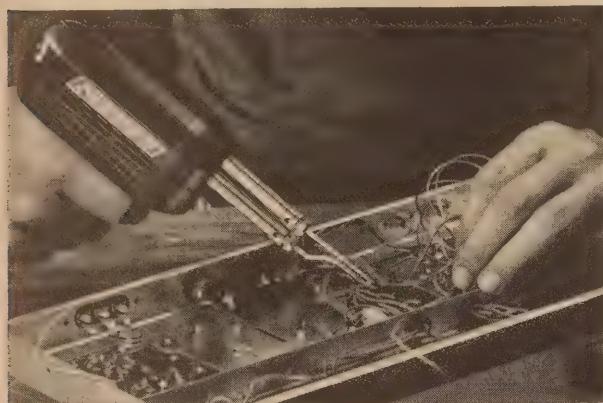
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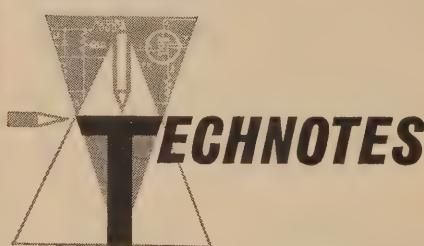
WORLD LEADER IN SOLDERING TECHNOLOGY

TELEVISION THE MOON

continued from page 79

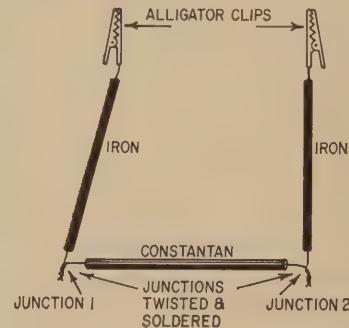
Rather than the usual mechanical tripod soft landing, which may not be wholly satisfactory, the balloon-like soft-landing arrangement is thought to be better.

These balloonettes can be anywhere from 20 to 30 feet in diameter and are inflated upon landing with an inert gas such as helium. Because the moon is airless, the balloons have no buoyancy but the equipment will land softly on account of retro-rockets. The robot lunar instrumentation will make seismic tests, exploring the moon for expected earthquakes. Chemical-physical tests are reported at intervals to earth. Due to the wide fluctuation of the lunar temperature, from 200° above to 250° below zero, it is expected that these fluctuations may give rise to cathode-ray like currents near the surface of the moon, which need investigation. How often do micrometeorites strike a given square yard on the airless moon? These and other questions will be answered by radio to earth.



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Make up a little thermocouple according to the drawing below and you'll have a quick, sure way of pinpointing electronic temperature-recorder troubles. Disconnect the ampli-

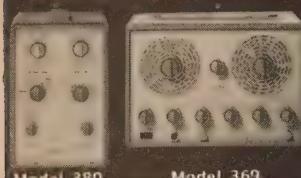


fier input leads from the measuring circuit and clip on the test couple. Warm junction 1 by grasping it between your thumb and index finger. The balancing motor should rotate. Release junction 1 and warm junction 2. The motor should stop and begin turning the other way. With a defective amplifier or motor, the system will operate in only one direction or not at all.—F. G. Lewis

Norelco 200 Tape Recorder Automatic Stop Won't Work

A Philips/Norelco 200 tape recorder was brought in to us with the complaint that when tapes with automatic stop foil were used, the machine failed to stop automatically as it should. We tried the mechanism by shorting the foil contacts with a screwdriver while the unit was in its PLAY function. All we got was a loud snap.

EICO's complete new color TV lab for the pro



Color TV servicing is a job for professionals—and EICO's new color TV test equipment is designed to their requirements. Critical professionals know they can depend on EICO for accuracy, reliability, and laboratory standard performance.

PROFESSIONAL PERFORMANCE COLOR TV TEST INSTRUMENTS

(A) **MODEL 380 SOLID STATE N.T.S.C. STANDARD COLOR SIGNAL & DOT-BAR GENERATOR (PAT. PEND.)** Completely standard 100% fully saturated N.T.S.C. color signals, including both chrominance and luminance signals exactly as specified. Color burst is precisely gated and delayed according to N.T.S.C. standards. Phase angles are permanently established by a linearly distributed delay line. No adjustments are ever required. Provides square "clean" waveforms without significant overshoots or ringing. In addition to generating 11 different color signals, one at a time, for hue and demodulator adjustments, the Model 380 generates dots, cross-hatch, horizontal lines, and vertical lines for convergence and linearity adjustments. Both video and RF outputs are provided, with gain controls. Three crystal-controlled oscillators for color burst and color information, convergence and sync signals, and RF output on TV channel. Outstandingly compact and weighs only 4 lbs. Kit \$129.95. Wired \$169.95.

(B) **MODEL 369 TV-FM SWEEP & POST-INJECTION MARKER GENERATOR (CRYSTAL-CALIBRATED)** For visual alignment of color or B&W TV, and FM receiver RF & IF circuits. Five sweep ranges from 3-220 mc and four marker ranges from 2-225 mc, plus a crystal marker oscillator. Sweep circuit is purely electronic. Retrace blanking. A 3-stage AGC circuit. Amplitude of the swept signal is consistent even when the widest sweep width of 20 mc is used. Only the sweep signal is applied to the circuit under test. The markers are added, and the combined signal is fed to a 'scope. Kit \$89.95. Wired \$139.95.

(C) **MODEL 435 DC WIDEBAND 3" OSCILLOSCOPE** You'll be able to complete many more color or B&W TV service calls on location if you can take your 'scope with you. EICO's 435 is really portable (1/3 the size of conventional 5" scopes) and fully equipped to do the job. Quality equal to or better than the finest 5" TV service scopes is achieved with a far sharper, brighter trace on a flat-face CRT. Flat from DC-4.5mc (+1, -3db). Zener diode-controlled square wave calibrating voltage, edge-lit calibration grid. Automatic sync full retrace blanking. Kit \$99.95. Wired \$149.95.

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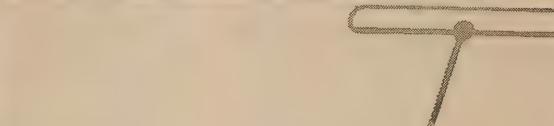
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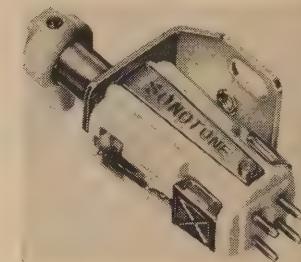


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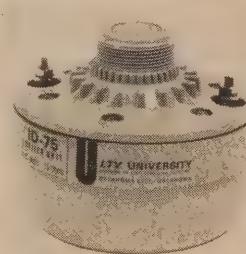
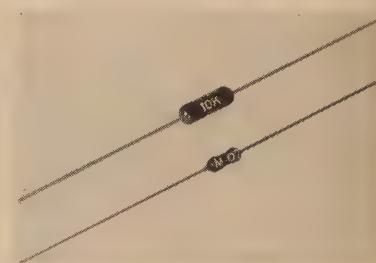
FM ANTENNA AMPLIFIER



Supercharger. Transistor 2N2495. Gain minimum +17 db. Bandpass 88-108 mc. Response, flat $\pm \frac{1}{2}$ db. Vswr input 1.2:1, output 1.25:1. Signal input 0.25 to 45,000 μ v; maximum signal output 360,000 μ v. Input and output impedance 300 ohms. 117 volts, 60 cycles, 2.1 watts.—Winegard Co., Burlington, Iowa.

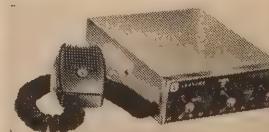
ance 1.0×10^{-6} cm/dyne, separation 12 db, tracking force 8 grams. Also plays LP, 45- and 78-rpm records. 2072: output 2.0 volts, other specs same as 2071. Model 14T: mono, output 3.6 volts, compliance 1.0×10^{-6} cm/dyne, tracking force 10 grams. With or without mounting bracket and turnover needle knob.—Sonotone Corp., Elmsford, N.Y.

METAL FILM RESISTORS



POWER DRIVER

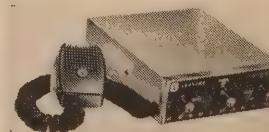
The ID-75, a 75-watt driver designed for high-power and special-purpose sound installations, closely resembles the firm's 30-watt driver in that it takes little space (4 1/4-in. diameter, 3 1/8-in. long). This is due to a new diaphragm design featuring a convex/concave configuration. Frequency response 150 to 7,000 cycles.—LTV University, 9500 W. Reno, Oklahoma City, Okla.



CRYSTAL CARTRIDGE REPLACEMENT

Model 20T1 and 20T2, both stereo. 20T1 (illustrated): output voltage 1.0, compli-

M-07 and M-20, of RL07 and RL20 type with parameters exceeding requirements of MIL-R-22684. 1% tolerance with TC of 100 ppm maximum. 1/4-watt M-07 rated for 250 volts; 1/2-watt M-20 at 350. Resistance values for M-07 from 50 to 150,000 ohms; M-20 from 50 to 500,000 ohms.—Clarostat Manufacturing Co., Inc., Dover, N.H.



TINY CB TRANSCEIVER

The Messenger III, has 18 transistors and 9 diodes, measures 2 1/4 x 6 1/4 x 8 1/8 in. It is interchangeable for mobile, base-station or portable field-pack use (5-watt battery powered). Double-conversion receiver with 4.3-mc first i.f. Will cover any 11 channels in the 23-channel band.—E. F. Johnson Co., Waseca, Minn.

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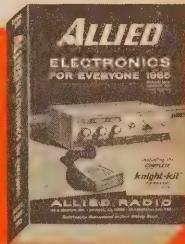
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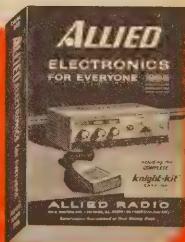
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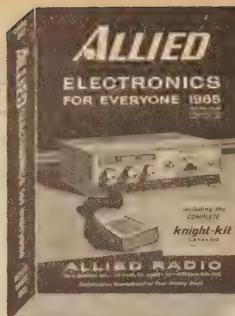
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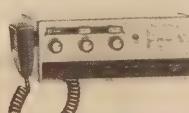


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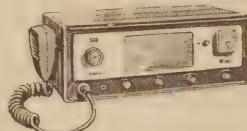


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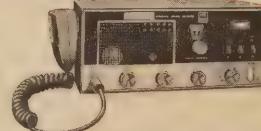


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TAPE RECORDER

Magnecorder 1028, for reels to 10½ in. at tape speeds of 7½ and 15 ips. Optional half- or quarter-track stereo heads. Plug-in transformers. Studio console or speech equipment. Portable case or adapter for rack or console mounting.—Midwestern Instruments, Inc., Magnecord Sales Dept., Box 7509, Tulsa 35, Okla.

STEREO CERAMIC CARTRIDGES

Models 21TR, 22T and 23T. Bracket of 21TR retracts into head of arm under pressure; 2 protruding buttons act as bumpers. Compliance 5.5×10^{-6} cm/dyne; output voltage 0.60. Channel separation 21 db. 21T: same cartridge with snap-in mounting bracket. 22T: same compliance, snap-in bracket, no retracting feature. 23T: output voltage 0.40, same compliance as other two, snap-in mounting, no retraction, but two "bottoming" buttons act as shock absorbers. All equipped with Sono-Flex needle. Sonotone Corp., Elmsford, N.Y.



COLOR SIGNAL GENERATOR

Model 980, delivers a signal that warms up to peak stability in 15 seconds and remains stable all day. Crystal-controlled color bars. Steel case. Produces: 10 keyed color bars; pattern of 54 dots for dc or static convergence; crosshatch pattern of 6 horizontal and 9 vertical bars for dynamic convergence; overscan and linearity adjustments; 9 vertical bars for adjusting dynamic horizontal convergence controls; 6 horizontal bars pattern for adjusting dynamic vertical convergence controls. Clip-on antenna leads hook unit to TV set.—Seco Electronics, Inc., 1201 S. Clover Dr., Minneapolis, Minn. 55420



CERAMIC STEREO CARTRIDGE

Featheride 149DF and *150DF* in 10-pack merchandising carton with point-of-sale literature. Spring-suspension permits cartridge to pivot when sudden force is applied, brings stylus off record surface and places soft "sole" on surface. Mounts in any arm with standard ½- or 7/16-in. mounting centers. 149DF tracks at 2-4 grams; 150DF at 4-6 grams.—Electro-Voice, Inc., Buchanan, Mich.



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COMPACT-PACKAGED STEREO SYSTEM



Called *M100* Maximum Performance Phono System, has a solid-state preamplifier/amplifier and 2 total-range, ultra-compact speaker systems. Unit is equipped with Shure V-15 Stereo Dynetic Cartridge, and turntable is Dual 1009. Has inputs for AM, FM, tape recorder and PA system. In the portable version, the two speakers make up one case; changer and amplification circuitry the other. Speaker case weighs 22 lb, changer 34 lb. Also available Library model in walnut.—Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Ill.



PORTABLE AMPLIFIER

Ampli-Vox model *S-700*, features one-knob operation. 10 flashlight batteries provide 200 hrs of operation. Output: 25 watts, 40 watts peak. Frequency response: 50 to 15,000 cycles. Two inputs. Outputs for two 8-ohm speakers. 8 1/2 x 3 1/4 x 8 1/4 in., weighs 7 lb with batteries.—Perma-Power Co., 5740 N. Tripp Ave., Chicago, Ill. 60646

GAS-DISCHARGE LAMPS

Choice of 12 spectral lamps ranging from sodium and mercury through cadmium and cesium, covering spectrum from ultraviolet to near infrared, are high energy units which emit full line spectra. To be used with power unit with dial control of

lamp power, fast-blow fusing, support for lamp-base mounting, with meter reading from 0.5 to 1.5 amperes.—Edmund Scientific Co., 105 E. Gloucester Pike, Barrington, N. J. 08007

DC TUBULAR CAPACITOR

Type *WPR*, in polystyrene dielectric film wrap, is recommended for precision-timing, high-Q tuned circuits, long-time constant circuits. It has low capacitance change with temperature, low dielectric absorption and high insulation resistance.—Cornell-Dubilier Electronics, 50 Paris St., Newark, N. J. 07101

STEREO AMPLIFIER



S-5500IV. Front panel features stereo headset jack, speaker disabling switch, gain control, stereo normal/reverse switch, invert switch, tape monitor switch, bass and treble controls, stereo or mono modes panel lights, and powered center channel for a middle channel or extension speaker. 12 db/octave scratch and rumble filters, tape playback preamplifiers, low-impedance outputs for tape recording. Music power is 80 watts. Phono sensitivity: 1.2 microvolts. Noise and hum measure 72 db below rated output. 9 tubes and 4 silicon rectifiers.—Sherwood Electronic Labs, Inc., 4300 N. California Ave., Chicago, Ill. 60618

BATTERY-OPERATED PORTABLE TAPE RECORDER



Wollensak 600 is first solid-state portable in line, weighs 4 lb., is 8 1/8 x 8 3/8 x 2 1/2 in. Constant-speed capstan drive allows interchange of tapes with any standard 2-track monaural recorder. VU meter indicates record level and battery condition. Other features: remote stop-start switch on mike,

record interlock, automatic tape lifter and 2 tape speeds, 3½ and 1½ ips. Operates on one 9-volt battery and six 1½-volt pen light cells.—Revere-Wollensak Div., 3M Co., 2501 Hudson Rd., St. Paul, Minn. 55119

TRANSISTORIZED ANTENNA BOOSTER



Genie Color Booster improves fringe-and metropolitan-area color TV and FM-stereo reception and combines an insertion gain of from 10 to 12 db, with noise factor as low as 4 to 6 db. Device consists of transistorized amplifier with universal mounting for any antenna boom or mast, wall or window frame, plus a remote power supply unit which doubles as two-set coupler. Operates continuously on approximately the same current used by an electric clock, or can be switched off.—Dept. MJ, Alliance Mfg. Co., Inc., Alliance, Ohio



TRANSISTOR REVERBERATION GENERATOR

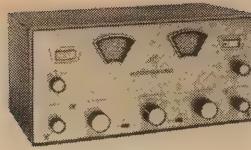
The *Reverbatape*, is compact (9 1/4 x 3 1/2 x 7 1/2 in.), controlled with a single knob, gives any electric organ "concert-hall-acoustics" in the living room. It is actually a small tape recorder which plays back sound at fraction-of-a-second intervals. Sold only in kit form.—*Schober Organ Corp.*, 43 W. 61 St., New York, N. Y. 10023

CERAMIC TRIMMER CAPACITORS

Modutrim line (microminiature) have ranges as high as 5-50 pf. Design is compatible with micromodule geometry and printed-circuit applications. These variable capacitors have maximum dimensions of 0.208 x 0.401 x 0.120 in. Nominal temperature coefficient of -250 ± 250 ppm/ $^{\circ}\text{C}$, exact values depending on capacitance range. Minimum Q at 1 mc is 500. Capacitance drift is 0.75% maximum in temperature cycling from -55 to $\pm 85^{\circ}\text{C}$. Line includes a 5-15-pf unit with a working voltage of 5,000, and 50-volt models with ranges of 2-20, 3-30, 4-40, 5-50 pf. Units have 180° rotation and linear straight-line capacitance curve.—**JFD Electronics Corp.**, 1462 62 St., Brooklyn, N.Y. 11219

GENERAL-COVERAGE RECEIVER

The HQ-66 is a 10-tube superhet continuously tunable from 540 kc to 30 mc in 4 bands. Has electrical bandspread tuning with direct dial calibration, temperature-compensated high-frequency oscillator

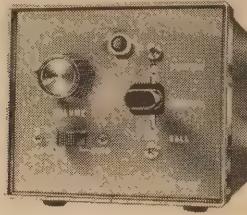


and built-in automatic noise limiter. Auto Response circuit permits complete range of audio response.—Hammarlund Mfg Co., 53 W. 23 St., New York, N. Y. 1001

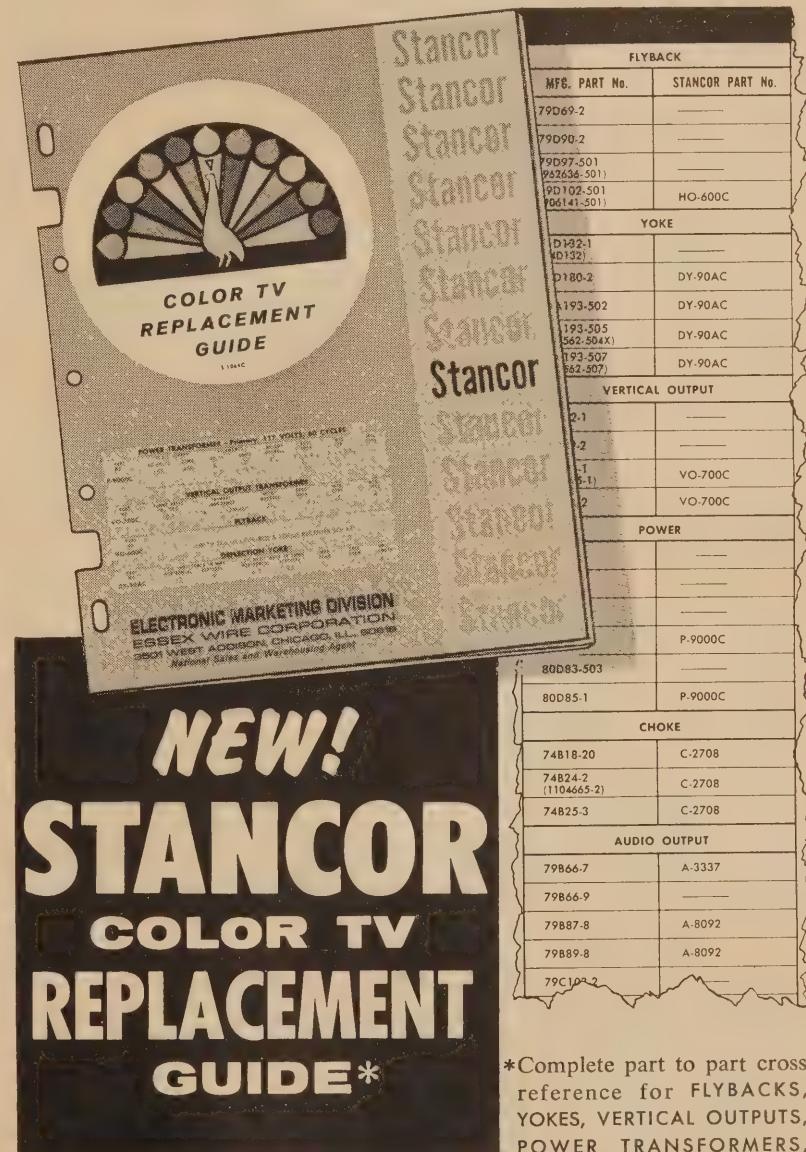
SELECTIVE CALLER

HA-200, dual-tone signaling device, minimizes possibility of hearing unwanted signals. Received tone of 1-second duration. Turns on signal light and activates receiver. Light stays on until manually reset. Each *Priva-Com* can transmit 10 different

combinations for greater privacy. Front panel has lever switch with standby, normal and call positions; a volume control;



speaker/horn switch and indicating light. Not recommended for transceivers with carbon mikes and no preamplifiers.—**Lafayette Radio**, 111 Jericho Turnpike, Syosset, N.Y.



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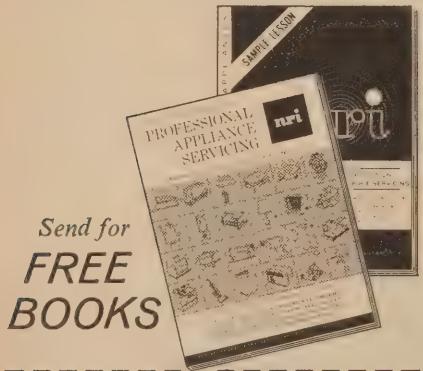
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STEREO TAPE DECK



Sony 263-E, in a walnut base, features vertical and horizontal operation, three $\frac{1}{4}$ -track stereo heads (erase, record and playback) and automatic shutoff. Has built-in stereo playback preamps for custom installation. *Model SRA-3* recording amplifier accessory converts the deck to stereo recorder. Power requirements: 117 volts, 20 watts, 60 cycles (50 cycles optional). Tape speeds: $7\frac{1}{2}$ and $3\frac{3}{4}$ ips. Frequency response: heads capable of 30-18,000 cycles at $7\frac{1}{2}$ ips. Flutter and wow: less than 0.25% at $3\frac{3}{4}$ ips. 14 x 11 x $6\frac{1}{2}$ in. 14 $\frac{1}{4}$ lb.—Superscope, Inc., 8150 Vineland Ave., Sun Valley, Calif.

.01-volt minimum increments. Resistance ranges: 1,000, 10,000, 100,000 ohms, 1 megohm. Accuracy: voltage, 0.1% of full scale, ± 1 count; resistance, better than 1%. Input impedance: 10-volt range—1 megohm; 100, 1,000 volt ranges—10 megohms. Polarity is automatically switched.



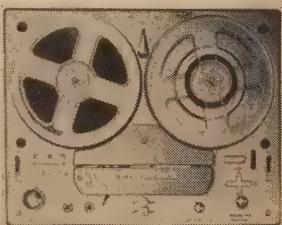
Decimal point controlled by range switch. Automatic off-scale indication. $\frac{1}{4}$ to $3\frac{1}{2}$ seconds display time. Operating temperature: to 105°F. 8 $\frac{1}{2}$ x 5 x $14\frac{1}{2}$ in., for 110-120-volt, 50-60 cycle ac. The KN-5000 is not a kit.—Allied Electronics Corp., 100 N. Western Ave., Chicago 80, Ill.



NEEDLE FORCE GAUGE

Of new design, supplied with turntables or sold separately. It will not touch pan or interfere with freedom of arm. Owners of the earlier type gauge may write for free replacement balance arm. Also any lost weights will be replaced.—Acoustic Research, Inc., 24 Thorndike St., Cambridge, Mass. 02141

STEREO TAPE RECORDER



Model 74B, new version of Tandberg's 3-speed/4-track, self-contained stereo tape recorder/playback unit. Includes FM multiplex filter, precision laminated heads, matched built-in speakers, power amplifiers, preamplifiers, pause control switch, 4-pole asynchronous motor, 2 built-in cathode-follower outputs, speaker selection for slide-projector synchronization and center-channel output for language laboratory use. Response: $7\frac{1}{2}$ ips 30-20,000 cycles (± 2 db, 30-16,000); $3\frac{3}{4}$ ips 30-14,000 cycles (± 2 db, 40-10,000); $1\frac{1}{2}$ ips 50-7,000 cycles (± 2 db, 55-5,000). Wow and flutter: 0.15% at $7\frac{1}{2}$, 0.2% at $3\frac{3}{4}$, 0.3% at $1\frac{1}{2}$. Signal-to-noise ratio: at least 55 db. Crosstalk rejection: better than 60 db.—Tandberg of America, Inc., 8 Third Ave., Pelham, N. Y.



COMMUNICATIONS TONE CONTROL

Model 524, provides 24 tone combinations in 3-tone sequential system. 2-way radios may be equipped to receive only desired calls on an all-unit or selective basis. A compact encoder-decoder using a resonant reed relay, the 524 is transistorized and current drain is negligible. Connections are made through the speaker and power supply of the transceiver with a microphone adapter plug furnished. 8 x 5 x 3 in., under 3 lb.—Cadre Industries Corp., Endicott, N.Y.

DIGITAL VOLTMETER OHMMETER

Knight KN-5000, solid-state circuit, latest conversion and digital techniques. Dc voltage ranges: ± 10 , ± 100 , $\pm 1,000$ with

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CAPSULE THERMISTOR COURSE No. 8, single looseleaf sheet. Part 2 of "Thermistors: Comparison with Thermocouples, Resistance Thermometers."—Fenwal Electronics, Inc., 63 Fountain St., Framingham, Mass.

CERAMIC CAPACITORS CATALOG, 40 pages, looseleaf punched, 2 colors. Full specs on disc, transistor-circuit plate, tubular, feedthrough, standoff capacitors. Also Hi-Q CK05, CK06; Cerafil, Cerol, Ceralam capacitors; thin-plate, micro-element, Aerocup, high-voltage cartwheel and HP capacitors.—**Aerovox Corp.**, Hi-Q Div., Olean, N.Y.

SILICON RECTIFIER STACK CATALOG, New modular assemblies described in 12-page, 2-color catalog. Detailed specs for single-phase center-tap assemblies, single-phase bridge assemblies, 2-phase bridge assemblies in current range from 3 to 75 amps. Photo, curves, outline drawings.—**Tung-Sol Electric Inc.**, 1 Summer Ave., Newark 4, N.J.

TAPE-HEAD REPLACEMENT GUIDE, 22-page, 5 x 8½-in. booklet, 3rd edition, covers replacements for over 440 separate tape recorder models, with erase-head replacement information on models formerly shown as "not available."—**Nortronics Co., Inc.**, 8101 10 Ave. No., Minneapolis 27, Minn.

SCR APPLICATION NOTE, AMS-34, describes applications of 2N3228 silicon controlled rectifier to speed-control circuits for fractional-horsepower, series-wound motors in hand tools and small appliances. 9 pages, looseleaf.—**RCA, Commercial Engineering, Electronic Components and Devices**, Harrison, N.J.

TEACHING SYSTEMS, Catalogs H-1, H-2. H-1 suggests experiments, parts, test equipment, text material, teaching aids for courses in electronic technology in 16-page brochure. 8-page Booklet H-2 does same for courses in digital computer fundamentals.—**Hickok Teaching Systems**, 545 Technology Sq., Cambridge, Mass.

MINIATURE CIRCULAR PLUGS CATALOG, KPT-2 A. 8-page, 2-color, looseleaf description of KPT/KSP plugs designed to MIL-C-26482C (Navy) specs. Includes drawings of contact arrangements and specs on wall mounting receptacles; cable connecting plugs; box mounting, through-bulkhead and jam-nut receptacles, straight plugs, 90° potting plug, suggested mounting dimensions.—**ITT Cannon Electric Inc.**, 3208 Humboldt St., Los Angeles, Calif. 90031

CATALOG, No. 140A, with \$1-value coupon good for merchandise in catalog. Test equipment, parts, tape recorders, transceivers, antennas, audio-hi-fi equipment, accessories, power tools, etc. 80 pages.—**Radio Shack Corp.**, 730 Commonwealth Ave., Boston 17, Mass.

HOW TO CLEAN, MAINTAIN AND PROTECT RECORDS. This booklet by Cecil E. Watts of "Dust Bug" fame, covers the subject completely, from how to handle records to record rejuvenating. Explains the how and why of dust films, static and related problems and how to get rid of them. Also covers such things as stylus pressures, and describes the author's Dust Bug, Parastat and Preener.—**Elpa Marketing Industries**, New Hyde Park, N.Y. 25¢

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of **RADIO-ELECTRONICS** on which the item appears.

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technicians' news

TESA-ST. LOUIS ELECTS

New officers of the Television Electronic Service Association of St. Louis, Mo., are Connie Bell, president; Charlie Varble, vice president; W. O. Hirschberg, secretary; Joe Dittrich, treasurer; Gene Love, NATESA director.

Chairman of the board is Bill Thomas. Directors are Ben Goedeker, Howard Frieren and Fred Reichman. Sergeant-at-arms is Gus Prionas.

TSADV DENIES FTC "RESTRAINT" CHARGES

The Television Service Association of Delaware Valley, headquartered in Philadelphia, has denied Federal Trade Commission charges of participating in unlawful conspiracy against parts wholesalers to restrain competition.

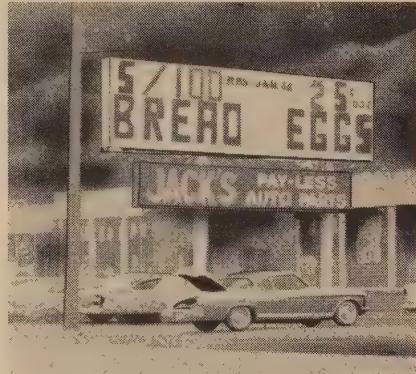
In a complaint made in May, the FTC charged that TSADV members conspired with each other and others outside the organization to restrict TV

parts distribution channels by boycotting wholesale suppliers who also sold retail. (See "FTC Files Against Delaware Valley Association," Technicians' News, RADIO-ELECTRONICS for August 1964, and "FTC-Delaware Valley Case Arouses Interest," in the September column.)

TSADV requested dismissal of the complaint. It denied that it at any time "combined, conspired, agreed or reached a common understanding that" it should act as the FTC charges.

STRIKING BACK

Fed up with supermarket and drugstore sales of motor oil, auto bat-



teries and auto accessories, this Seattle auto parts store and service station has

begun selling bread, jam, canned goods, eggs and butter.

Big placards offering the groceries at discount prices are prominent in front of the establishment on a main Seattle artery.

Back to the general store?

WISCONSIN GROUPS GET NEW OFFICERS

The TV-Electronic Service Association of Racine, elected Herman DeLitz president. Vice president is Charles Sargent; treasurer, Dick DeMoupled, and secretary, Tony Minetti.

Outgoing president William Bush is serving as NATESA director.

The Milwaukee TESA also elected officers. Gerald Hall was chosen president; Don Mueller, vice president; John Stanczak, treasurer, and Clarence Saatkamp, secretary. Ken Mueller is NATESA director.

ASTRONOMERS' TECHNIQUES IN ELECTRONICS

An interesting feature of the prototype manned-control system Project 465L (mentioned in News Briefs, page 6, September Radio-Electronics), for the Strategic Air Command is that it uses methods till now found only in astronomy. Those methods are applied in servicing the giant computer.

Two Polaroid cameras are mounted facing the main control board of the

"MOVING OUT SALE" N.Y.C. TEARING DOWN 13 BLOCKS FOR TRADE CENTER & WE'RE IN IT

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DIO Style, Quality, Performance
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The big board of the Data Processing Central, Project 465L, at International Telephone & Telegraph's Prototype SAC Command Control System.

Data Processing Central. Banks of winking lights on the big board indicate whether or not the various portions of the equipment are working correctly. If some portion of the equipment is malfunctioning, it is usually possible, because of the redundancy of circuits, to continue operating.

Photographs of the two halves of

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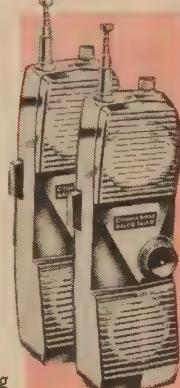
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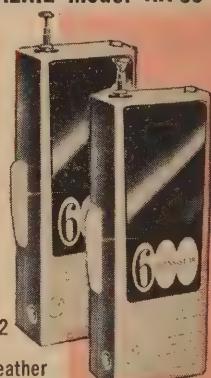
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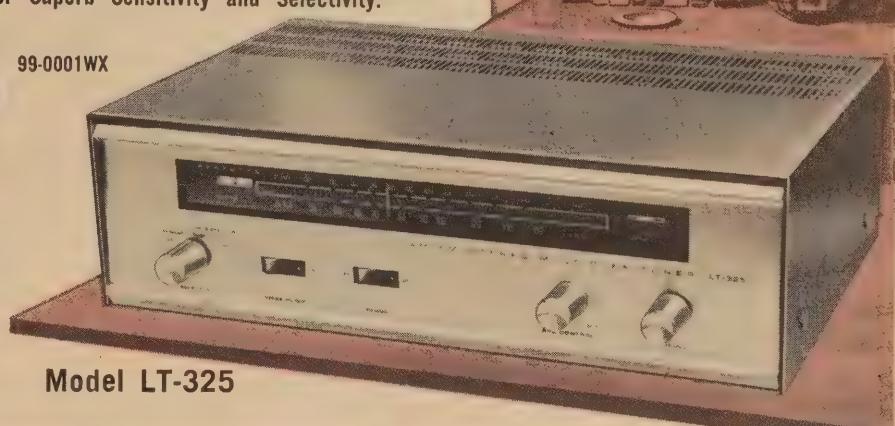
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NEW! LAFAYETTE 23-CHANNEL CRYSTAL-CONTROLLED DUAL CONVERSION 5-WATT CB TRANSCEIVER

WITH ADVANCED "RANGE-BOOST" CIRCUIT



Double Side Band Full Carrier

**Model
HB-400**
99-3001WX

169⁵⁰

- ✓ 17-Tube Performance with 13 Tubes
- ✓ Low Noise Nuvistor "Front End"
- ✓ 5 Double-Tuned If Transformers
- ✓ Meets All FCC Requirements

- Frequency Synthesized Circuit Provides 23 Crystal-Controlled Transmit & Receive Channels—No Extra Crystals to Buy!
- Continuous One-Control Channel Tuning
- Full 5-Watt Input
- Push-To-Talk Microphone & Electronic Switching
- Dual Conversion Receiver With 3/10 μ V Sensitivity
- Delta Tuning Offers "Fine Tuning" of ± 2.5 Kc on Receive
- Illuminated "S" and RF Output Meter
- Variable Squelch, Variable Noise Limiter, AGC
- Built-in 117V AC & 12V DC Power Supply
- "Vari-Tilt" Mounting Bracket for Easy Mobile Installation
- Plug-in Facilities For Lafayette Selective Call Unit

Efficient, dependable 2-way communications in any fixed or mobile application is assured with this rugged, new 5-watt CB transceiver. A military-type frequency synthesizing circuit makes it possible to transmit and receive over the full range of 23 channels with crystal-controlled accuracy—no extra crystals to buy and install!

Efficient circuit with 13 tubes and 8 diodes offers maximum transmitter power output . . . high receiver sensitivity—plus every feature CB users want!

Operates in a fixed or mobile location with equal ease . . . has built-in power supply for either 117V AC or 12V DC. Specially designed "Vari-Tilt" mounting bracket simplifies mobile installation—permits fast removal of the transceiver too! And, there's nothing else to buy—you get all crystals, push-to-talk ceramic mike, and a built-in vibrator for 12V DC, plus 2 power cables. Measures a compact 12Wx5Hx10"D.

ADVANCED "RANGE-BOOST" CIRCUIT

Increases Your Effective Range—Lets You Get Through When Others Fail!

Want to effectively increase your range? You can—with Range-Boost! A simple turn of a switch on the HB-400 increases the average percentage of modulation and lets your voice cut through QRM and noise to reach further . . . gives you more "talk-power" when you need it—without overmodulating!

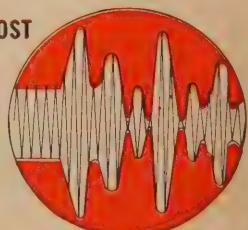
CONVENTIONAL

Average Percentage of Modulation Is Lower



WITH RANGE-BOOST

Average Percentage of Modulation is Higher—Sideband Power is Increased



Headquarters For Citizens Band Equipment

NEW! LAFAYETTE ALL-TRANSISTOR DUAL CONVERSION 5 WATT CB TRANSCEIVER

FEATURING AUTHENTIC MECHANICAL FILTER

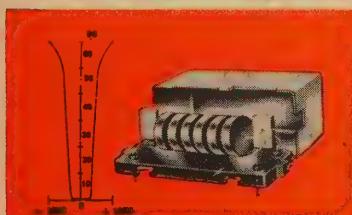
Model HB-500



- ✓ 100% Solid-State . . . Full 5-Watt Performance!
- ✓ Small, Compact—Only 11-7/16Wx6-11/16Dx3" H
- ✓ Low Battery Drain—Less Than 350 ma on Receive, 850 ma on Transmit!

- 12 Crystal Transmit plus 12 Crystal Receive Positions
- 23 Channel Tunable Receiver with Vernier Tuning
- Dual Conversion Receiver with 5/10 μ V Sensitivity
- 15 Transistors, 3 Diodes, 2 Zener Diode plus 1 Thermistor
- Zener Diode Voltage Regulated Receive Oscillator for Superior Frequency Stability
- Dependable Sealed Relay Switching
- Automatic Noise Limiter
- Variable Squelch
- For 12 Volt DC Mobile Operation (Negative or Positive Ground) or for 117V AC Operation when used with Matching Solid State AC Power Supply (Optional)
- Meets All FCC Regulations

HIGHLY SELECTIVE MECHANICAL FILTER



With CB channels only 10 Kc apart, selectivity is important! In the HB-500, ultra-sharp selectivity is achieved by means of a true mechanical bandpass filter in the 455 Kc IF section. At 10 Kc on either side of the center frequency, the filter provides 60 db of attenuation—an extremely high rejection ratio that assures complete adjacent channel rejection!

RUGGED, HEAT RESISTANT TRANSISTORS USED IN ALL CRITICAL AREAS

EPITAXIAL SILICON, MESA TRANSISTORS used in Transmitter Oscillator, Driver and Final Stages.

SILICON MESA TRANSISTORS used in Receiver Oscillator, RF and IF Stages.

If you're looking for a high-performance CB transceiver in a small, compact size, you'll want the HB-500! Using advanced solid-state circuitry, this transceiver is small enough to fit conveniently into the most compact car. And, battery drain is really low! The transceiver draws no more than .35 amps on receive, .85 amps on transmit—an important advantage in mobile applications! This rugged transceiver offers instantaneous, cool-running operation and features printed circuit, all-transistor design. Equipped with mobile mounting bracket, push-to-talk dynamic microphone, crystals for operation on channel 12.

Model HB-501 Solid State AC Power Supply

Matching solid state AC power supply for HB-500 for fixed station operation (at home, business, office). Transceiver rests on power supply to form attractive integrated unit. Size 11 $\frac{1}{2}$ Wx6 $\frac{1}{2}$ Dx3 $\frac{1}{2}$ H.
99-3028 Net 16.95



SPECIAL INTRODUCTORY OFFER!

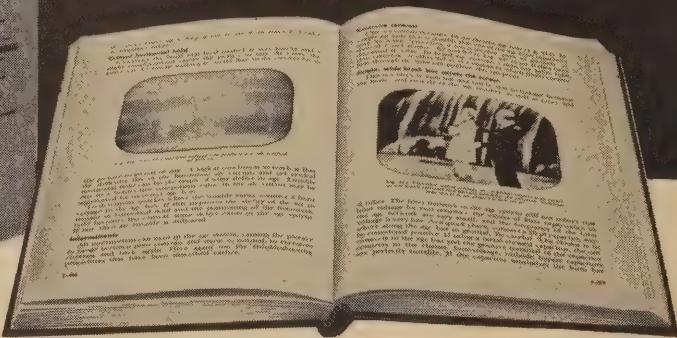
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Answers to

What's Your Eq?

This month's puzzles are on page 48

Step Up to the Counter

Since the voltages across capacitors in series are inversely proportional to the values of the capacitors,

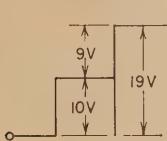
$$E_{C1} = E_{in} \left(\frac{C_2}{C_1 + C_2} \right)$$

(Assume $C_1 = 1\mu F$ and $C_2 = 9\mu F$)

So, $E_{C1} = 90$ volts and

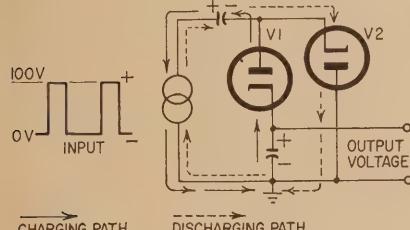
$E_{C2} = 10$ volts.

Since the output is taken across C_2 , it is 10 volts. When the input volt-



age drops to zero after the first pulse is applied, C_1 discharges through V_2 and the generator. C_2 cannot discharge because the cathode of V_1 is positive with respect to the plate.

When the second pulse is applied to the input, we have only 90 volts applied, because the capacitor C_2 is



charged 10 volts and bucking the 100 volts.

The same principle applies for the second pulse as for the first. We have 81 volts across C_1 and the remaining 9 volts across C_2 . So the output will now be 19 volts, since the 9 volts is added to the initial 10.

When the input drops to zero again, C_1 discharges while C_2 keeps its full charge. As more pulses are applied, the output keeps increasing in smaller steps.

Bypasses and Bypasses

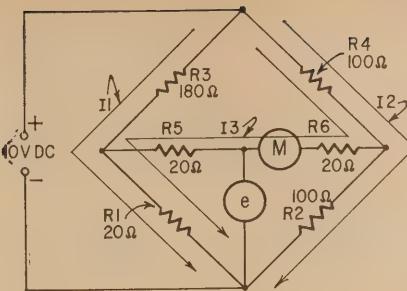
Equation

$$200I_1 + 20I_2 = 10$$

$$100I_2 + 160I_3 + 20I_1 = 10$$

$$180I_1 - 40I_2 + 100I_2 = 10$$

Equate last two, which gives $200I_3 = 160I_1$ or $I_1 = 5/4I_3$. Substitute this into first equation, and



$$I_3 = M = .037037. \text{ So } I_1 = .046296$$

$$e = E_{R6} + E_{R1} = 20I_3 + 20(I_1 + I_3) = 0.74074 + 1.66666 = 2.40740 \text{ volts.}$$

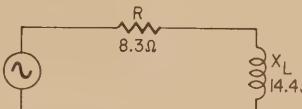
Phase Angle

The trick here is to assume a voltage, say 10, across the parallel branch to find the equivalent current and reactance.

$$I_L = \frac{10}{8} = 1.25 \text{ amp,}$$

$$\text{and } I_C = \frac{10}{18} = 0.556 \text{ amp}$$

As the currents are 180° out of phase, the equivalent current equals their differ-



ence, or 0.694 amp. Again using our assumed voltage, the equivalent reactance is found.

$$X_L = \frac{10}{0.694} = 14.4 \text{ ohms}$$

$$\text{P.F.} = 0.5 = \cos \theta; \theta = 60^\circ,$$

$$\text{and } \tan \theta = 1.732 = \frac{X_L}{R}$$

$$R = \frac{14.4}{1.732} = 8.3 \text{ ohms}$$

END

Coming next month Radio-Electronics Special TEST EQUIPMENT ISSUE

- Reviews and articles on new test equipment.
- A rundown on stereo multiplex generators.
- A fundamental story on meters in electronic servicing.
- How to increase the usefulness of your test instruments.
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• Reports on new test equipment.

• A rundown on stereo multiplex generators.

• Instrument construction and modification.

Plus...

Many other articles, features and regular departments in next month's RADIO-ELECTRONICS.

NOVEMBER ISSUE
(on sale October 20)

2160 unijunction transistor form a relaxation oscillator that triggers the gate circuit of the SCR through the transformer.

Base 1 of the 2N2160 returns to ground through the primary of the transformer. Base 2 is biased positive by the voltage divider (R2 and R3) connected across the battery. The 2N2160's firing point is determined by the emitter voltage and the voltage between the bases. Since the transistor is supplied by the battery, its firing point increases as the battery charges.

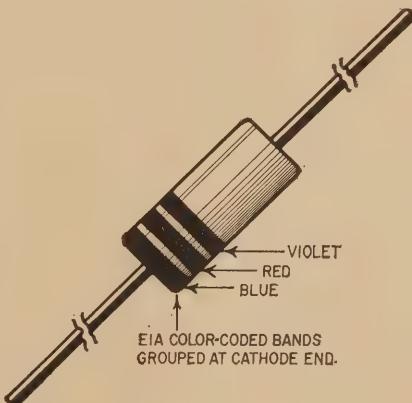
When the battery voltage reaches a preset level, the Zener diode breaks down and the transistor stops oscillating. This cuts off the SCR and the charging stops. The cutoff point is determined by the setting of the 1,000-ohm pot.

The battery must supply at least 3 volts with the indicated polarity before the unijunction will oscillate and start the charging operation. Thus, the circuit will not operate if the battery polarity is reversed or if the load is short-circuited or open.

The transformer is wound on a Ferroxcube type 203 F 188-3C3 core. The primary has 30 turns of No. 22 insulated wire and the secondary has 45 turns of the same wire. When wound, the transformer must have a low series impedance and be able to pass a pulse a few μ sec wide.

DIODE COLOR CODE

SEVERAL READERS HAVE ASKED FOR HELP in identifying color-coded crystal diodes



often used in electronic equipment. Most crystal diodes are marked according to the standard EIA (formerly RETMA and RMA) color code as follows:

1—Brown	6—Blue
2—Red	7—Violet
3—Orange	8—Grey
4—Yellow	9—White
5—Green	0—Black

The color bands start from the *cathode* end and represent the digits following the 1N prefix. For example, the diode in the drawing is a 1N627. END

NEW SAMS BOOKS

Know Your Color-TV Test Equipment

by Robert Middleton. To use Color-TV test equipment properly, the technician must understand its capabilities and limitations, and its proper application. This book explains clearly and easily the function and circuit action of each Color-TV instrument—shows how to service, calibrate, and maintain it for continuous, reliable service. Covers: White-Dot and Cross-Hatch Generators, Color-Pattern & Color-Bar Generators, Rainbow & NTSC Generators, Principles of Video-Frequency Sweep Generators & Testing, Lab-type equipment, and useful setup information. Profusely illustrated. An invaluable book for anyone using Color-TV test equipment. $5\frac{1}{2} \times 8\frac{1}{2}$. Order **KOC-1**, only..... \$2.95

Radio Service Training Manual

by Edward P. Rice. Offers an extremely successful system for quickly locating troubles in radio receivers—based on the use of carefully selected key circuit points, where test results will give positive indications. Programmed trouble-shooting charts show how to quickly isolate trouble to specific components. Covers both tube and transistor type receivers. Fully illustrated. $5\frac{1}{2} \times 8\frac{1}{2}$. Order **RSS-1** (softbound), only..... \$4.95 Order **RSH-1** (hardbound), only..... \$6.95

Radar License Endorsement Handbook

by Edward M. Noll. Provides all the information needed to pass the FCC Element 8 license examination for the radar endorsement. Provides, in addition, a firm grasp of radar fundamentals, plus a practical knowledge of modern marine and other radar equipment. The book includes tables, laws, and procedures which will remain permanently helpful after you have passed the examination. $5\frac{1}{2} \times 8\frac{1}{2}$. Order **R LH-1**, only..... \$2.95

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TV Receiver Tube Usage Guide

A "must" for the shop and the tube caddy—saves time and eliminates wasted service calls. Lists all tubes, semiconductors, and fuses used in 1963-64 TV receivers, so you can quickly check your caddy before you start out on a service call, to see whether it contains the proper tubes. Tubes are listed by function; a tube usage section provides a valuable guide to proper tube stocking. Where wire or circuit-breaker performs fuse function, this fact is noted. Indexed by receiver model and chassis number. Includes information on alternate tubes when used. $5\frac{1}{2} \times 8\frac{1}{2}$. Order **TUR-1**, only..... \$1.95

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TRICKS FOR EXTRACTING PILOT LAMPS

Most jewel-covered, panel-mounted pilot lamps are impossible to remove with bare hands—they are recessed too deeply for fingers to grasp. An ordinary wedge-shaped eraser (the kind that slips over the end of a pencil), sold in most dime stores, makes a handy tool. Also, the outer insulation from $\frac{1}{2}$ -inch diameter coaxial cable works equally well. In each case, push the tool onto the bulb and twist. Then tool and bulb can be easily removed.—Thomas R. Haskett

CLEANS YOUR DIALS WHILE IT CLEANS YOUR TEETH

When plastic dials and faces on important instruments get scratched and dull, high-polish them like new by using dentifrices as buffering compounds.

Make a paste of a small quantity of toothpowder and water and rub this mixture on the plastic with a piece of felt. The powder removes small scratches and marks from the plastic.

Then use another piece of felt, apply toothpaste, wet it slightly and buff away until you're satisfied.—Henry Mullen

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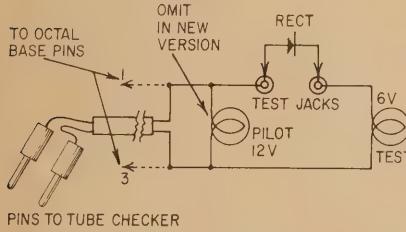
Tube	Price	Tube	Price	Tube	Price	Tube	Price	Tube	Price	Tube	Price	Tube	Price	Tube	Price
0A2	...80	3B8U	.76	6AF3	.1.02	6CA4	.70	6GG6	1.00	7B7	.1.95	12C5	.56	17L6	1.25
0A3	...90	3B8V	.56	6AF4	.99	6CA5	.39	6GE5	.65	7B8	.1.25	12C5N	.54	18A5	1.54
0A4G	1.35	3BZ6	.54	6AF5	.99	6CB6	.35	6GGF5	1.75	7C4	.69	12CR6	.65	18F6	.47
0B1	1.20	3B8U	.50	6AF6	.99	6CB7	.53	6GK5	.59	7C5	.1.00	12C6	.65	18F6	.38
0B3	1.20	3B8V	.50	6AF7	.99	6CE5	1.98	6GK6	.77	7C6	.1.90	12CX6	.62	18FV6	.48
0C3	1.75	3C6E	1.05	6AG5	.68	6CD6	1.45	6GGK6	.77	7E6	.68	12D4	.67	19AU4	.85
0D3	80	3C5E	.56	6AG7	4.10	6CG6	.95	6GL7	2.35	7E6	.68	12DB5	1.05	19BG6	1.35
0E3	1.75	3C75	1.05	6AG8	.99	6CG7	.98	6GM5	1.00	7E7	.77	12DZ2	.60	19BG6	.68
0Y2	1.00	3D4E	.48	6AH6	1.05	6GG6	.78	6GM6	1.10	7EY6	.77	12DL8	.85	19HV8	1.44
0Z4	77	3D4G	.88	6AJ5	1.95	6GL5	1.69	6GN8	.92	7F7	.75	12DQ8	1.02	19JN8	1.20
1A3	73	3DK6	.58	6AJ6	1.73	6CL6	.77	6GGT5	1.95	7F8	1.95	12DQ7	1.33	19TB8	.83
1A5	73	3DK8	.58	6AJ7	1.73	6CM6	.77	6GGT6	1.95	7F8	1.95	12DQ8	.82	19TB8	1.20
1A6	73	3DZ4	1.59	6AK6	.94	6CM7	.67	6GVB6	1.85	7H7	.95	12DQ8	.82	19TB8	1.20
1A7	1.05	3GK5	.97	6AL5	1.60	6CM8	.60	6GGW6	1.85	7H8	1.67	12DT7	.77	22BW3	1.43
1AB5	70	3HS8	1.29	6AL6	2.10	6CM9	.60	6GGW6	1.50	7I7	1.65	12DT8	.76	22DE4	1.53
1AB6	70	3HS9	.34	6AL7	2.11	6CO4	.60	6GGW6	1.50	7I7	1.65	12DT8	.76	22DE4	1.53
1AF4	1.30	3V4	.73	6AM8	.76	6CQ7	1.80	6GQ9	2.25	7L7	1.65	12DV8	1.20	25AC5	2.00
1AG4	2.20	3V4	.61	6AN4	3.16	6CQ9	.90	6GY6	1.10	7N7	1.75	12DW8	.87	25AK4	.66
1AJ5	1.05	4AU6	.94	6AN5	1.95	6CR6	.58	6GZ5	1.10	7O7	1.50	12DZ2	.60	25AV5	1.10
1AX2	1.05	4AU7	.94	6AN6	1.95	6CR7	.58	6GZ6	1.10	7O7	1.50	12EAG	.98	25BK8	1.50
1B5	77	4BAG	.85	6AN8	1.95	6CS7	.67	6HF8	.75	7S7	1.60	12ED5	.60	25BW6	1.05
1C5	73	4B8C	.85	6AN9	1.95	6CU5	.56	6HG8	1.95	7T7	1.35	12ED5	.60	25BW8	1.05
1D5	73	4C8B	.85	6AN10	1.00	6CU6	.56	6HG8	1.95	7T7	1.35	12ED5	.60	25BW8	1.05
1D5GP	.98	4BNG	1.46	6AQ8	2.00	6CW4	.90	6HG8	1.95	7T7	1.35	12ED5	.60	25BW8	1.05
1D7	78	4BQ7	.99	6AR5	1.03	6CW5	.10	6J4	.295	7V4	.67	12E8L	.86	25CD6	1.50
1D8	2.20	4BQ8	.98	6AR6	1.50	6CW6	.10	6J6B	.98	7V4	1.25	12E8L	.86	25CD6	1.50
1E5	1.30	4BZ6	1.30	6AR7	1.50	6CW7	.10	6J6B	.98	7V4	1.25	12E8L	.86	25CD6	1.50
1E5GP	.98	4BZ6	1.30	6AR11	1.70	6CY7	.69	6JER	.50	8AU8	.93	12F5	.50	25EH5	.53
1E7	.87	4BZ7	1.56	6AS5	.55	6CZ5	.80	6JSM	.92	8AW8	.93	12FA2	.50	25L6	.55
1F4	.68	4CB6	.95	6AS6	1.00	6D4	.68	6J6	.69	8BQ5	.63	12FK2	.78	25SK4	1.10
1F5	.68	4CB7	.95	6AS7	1.00	6D5	.68	6J6	.69	8BQ5	.63	12FM2	.48	25Z6	1.10
1F6	1.20	4CV5	1.25	6AS8	1.20	6D6	.25	6J8	1.20	8C7	.63	12FM2	.48	25Z6	1.10
1G3	.77	4D6E	1.19	6AS11	1.95	6D10	.19	6J11	1.83	8C7N	1.00	12F5X	.94	27GB5	.59
1G4	.69	4DK6	.57	6AT6	.47	6DAS	.19	6J12	1.83	8C7N	1.00	12F5X	.94	27GB5	.59
1H1	.95	4EH7	1.25	6AU4	.83	6DB5	2.30	6K7	.295	7V4	.67	12G6C	.86	33GY7	2.99
1H5	1.00	4EJ7	1.55	6AU5	1.75	6DC5	1.30	6K7	.95	8FQ7	.54	12J5	.75	34GD5	.79
1H6	73	4EM5	.94	6AU6	.50	6DC6	1.33	6K7G	.75	8R8N	1.58	12L18	.82	35BS5	2.23
1H7	.73	4EM6	.94	6AU7	.50	6DC7	1.33	6K7H	.75	8R8N	1.58	12L18	.82	35BS5	2.23
1J5	.98	4EW6	1.19	6AU8	.50	6D6	.58	6K11	1.50	9AB8	.93	12K5	.73	35CS5	.49
1J6	.98	4GK5	1.59	6AV5	1.75	6DE6	1.33	6KDB	.99	9AU7	1.19	12L6	.71	35EH5	.84
1K3	.77	4GM6	.59	6AV6	.39	6D6G	.56	6L5	.90	9BR7	1.32	12L8	.50	35W4	.40
1L4	.50	4GZ5	.59	6AV7	.39	6D6H	.56	6L5C	.90	9C8	.77	12L8	.50	35W4	.40
1L5	1.28	4GZ6	.59	6AV8	.39	6D6K	.56	6L6	.90	9C8	.77	12L8	.50	35Y4	1.63
1L6	1.20	4GZ7	.59	6AV9	.39	6D6L	.56	6L6G	.95	9C8	.77	12L8	.50	35Y4	1.63
1L7	1.20	4HMG	1.00	6AX3	1.05	6D6N	.56	6L6M	.95	10C8	1.64	12A5	.60	35Z3	1.95
1L8	1.55	4HS8	1.00	6AX4	.65	6D6T	.15	6L7	.1.05	10D7	1.35	12C5T	.78	36AM3	.78
1L9	1.55	4HS9	1.00	6AX5	.65	6D6U	.15	6L7	.1.05	10E6G	1.75	12F5T	.57	50AS5	1.70
1L10	.98	4JC6	1.64	6AX6	2.10	6D6V	.05	6NG6	1.45	10F7	.54	12I5	.75	50AS5	.67
1L11	1.95	4JD6	1.64	6AX7	2.10	6D6W	.05	6NG7	1.45	10F7	.54	12I5	.75	50AS5	.67
1L12	1.95	5MB5	1.64	6AX8	1.45	6D6X	.05	6NG8	1.45	10F7	.54	12I5	.75	50AS5	.67
1L13	1.75	5MB6	1.64	6AX9	1.45	6D6Y	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L14	1.50	5MB7	1.64	6AX10	1.45	6D6Z	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L15	1.75	5MB8	1.64	6AX11	1.45	6D6A	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L16	1.75	5MB9	1.64	6AX12	1.45	6D6B	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L17	1.75	5MB10	1.64	6AX13	1.45	6D6C	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L18	1.75	5MB11	1.64	6AX14	1.45	6D6D	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L19	1.75	5MB12	1.64	6AX15	1.45	6D6E	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L20	1.75	5MB13	1.64	6AX16	1.45	6D6F	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L21	1.75	5MB14	1.64	6AX17	1.45	6D6G	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L22	1.75	5MB15	1.64	6AX18	1.45	6D6H	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L23	1.75	5MB16	1.64	6AX19	1.45	6D6I	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L24	1.75	5MB17	1.64	6AX20	1.45	6D6J	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L25	1.75	5MB18	1.64	6AX21	1.45	6D6K	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L26	1.75	5MB19	1.64	6AX22	1.45	6D6L	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L27	1.75	5MB20	1.64	6AX23	1.45	6D6M	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L28	1.75	5MB21	1.64	6AX24	1.45	6D6N	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L29	1.75	5MB22	1.64	6AX25	1.45	6D6O	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L30	1.75	5MB23	1.64	6AX26	1.45	6D6P	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L31	1.75	5MB24	1.64	6AX27	1.45	6D6Q	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L32	1.75	5MB25	1.64	6AX28	1.45	6D6R	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L33	1.75	5MB26	1.64	6AX29	1.45	6D6S	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L34	1.75	5MB27	1.64	6AX30	1.45	6D6T	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L35	1.75	5MB28	1.64	6AX31	1.45	6D6U	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L36	1.75	5MB29	1.64	6AX32	1.45	6D6V	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L37	1.75	5MB30	1.64	6AX33	1.45	6D6W	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L38	1.75	5MB31	1.64	6AX34	1.45	6D6X	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L39	1.75	5MB32	1.64	6AX35	1.45	6D6Y	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L40	1.75	5MB33	1.64	6AX36	1.45	6D6Z	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L41	1.75	5MB34	1.64	6AX37	1.45	6D6A	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L42	1.75	5MB35	1.64	6AX38	1.45	6D6B	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L43	1.75	5MB36	1.64	6AX39	1.45	6D6C	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L44	1.75	5MB37	1.64	6AX40	1.45	6D6D	.05	6NG9	1.45	10F7	.54	12I5	.75	50AS5	.67
1L45	1.75	5MB38	1.64	6AX41	1.45	6D6E	.05								

a small, flat piece of steel. Bend these two ends down at right angles. Use a hot soldering iron to push the steel into the plastic opposite the magnet. Now when the door is closed the magnet will hold the door shut. This prevents the door from getting broken off its plastic hinges. The idea will work on any aluminum or nonmetallic control doors.—Homer L. Davidson

SUPER-SIMPLE RECTIFIER CHECKER

This is an improved version of a rectifier checker described on page 117 of the February 1958 issue of **RADIO ELECTRONICS**. The diagram shows the circuit of that unit. When the test jig is connected to 12 volts ac, the 12-volt lamp lights to full brilliance. A good rectifier between the test jacks rectifies alternate half-cycles of the ac wave and thus cuts power about in half—enough to light the 6-volt lamp to full brightness. A shorted rectifier puts the full 12 volts on the 6-volt lamp, making it flare, while a weak or open rectifier lights the 6-volt lamp only dimly or not at all.

I built my version into an old 0Z4 tube envelope, with the test jacks on the

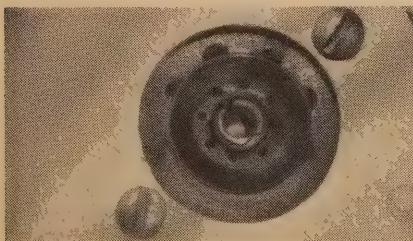


side. Pins 1 and 3 are the power connections, and the adapter plugs right into the octal socket of the tube tester. I used only the 6-volt lamp, and I always start the test by throwing the tube checker's filament voltage selector to 6 volts. That way, a shorted rectifier doesn't sock the 6-volt lamp with the full 12 volts, and the lamp lasts much longer.

Built into the old tube shell, the checker is a handy gadget that takes up very little space in the tube caddy.—Charles Andrews

OCTAL-TO-7-PIN-MINIATURE SOCKET ADAPTERS

When you want to replace an old octal-base tube with a newer seven-pin miniature type in existing equipment,



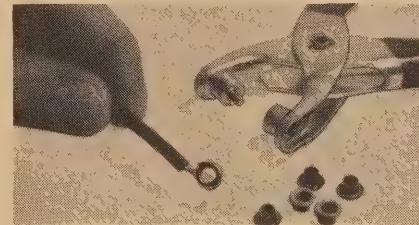
try this trick in chassis that use phenolic wafer type octal sockets and 1-inch socket holes.

Take an octal wafer socket (use the one in the set if you wish), separate the wafers by reaming out the rivets, and punch a $\frac{5}{8}$ -inch hole in the center

of the top wafer, using a $\frac{5}{8}$ -inch chassis punch. Since the phenolic material is soft, you can easily file or ream the center keyway to $\frac{5}{8}$ -inch diameter. Then slip in a retainer-ring-mounting seven-pin miniature socket (like Amphenol 78-7P).

Another possibility is to use saddle-mount sockets (Amphenol 147-500 or equivalent), with the metal saddle sandwiched between the two octal socket wafers. No screws are needed.—James Wallace

QUICK AND EASY EYELETS MAKE NEAT CONNECTIONS



If you have an eyelet tool like the one shown, you have the means for putting neat eyelets in the ends of electric wires. Just wrap the wire around an unpainted eyelet and secure it with the pliers. Ordinary hollow rivets may be used as wire eyelets in a similar way.—John A. Comstock

TEST SELENIUM RECTIFIERS WITH R-C BRIDGE

To check selenium rectifiers and silicon diodes, I use an Eico 950-B R-C bridge, which has a leakage-checker range. I connect the plus terminal of the checker to the anode terminal of the rectifier or diode, using the ELECTROLYTIC LEAKAGE range of the checker. The minus terminal goes to the cathode terminal of the rectifier or diode. I turn up the voltage control of the checker until the "eye" just closes. This will happen at 10 to 50 volts. I reverse the connections to the rectifier or diode, and again turn up the voltage. The "eye" doesn't close on a good unit.

If the eye closes on a low voltage on the first tests, the unit is not open. If, on the reverse connection, the eye does close, the unit is shorted or leaking badly.

If the eye closes only under higher voltage, the unit has high resistance or is open.

I find this method more reliable than using an ohmmeter, because the test voltage is higher and also adjustable to the ratings of the diode or rectifier. I have used this method on portable radios, TV sets, vtvms, etc., without disconnecting the rectifier from the circuit.

In some cases, a wire must be disconnected from the circuit, if there is a low-resistance shunt. Take care not to exceed the voltage rating of the tested unit but, in the Eico R-C bridge, the current is very low.

This method could also be used to check transistors, Zener diodes, etc.—Oscar Blair

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MODERN ELECTRONIC VOLTMETERS, by Sol D. Prensky. *John F. Rider Publisher, Inc., 116 W.*

14 St., New York, N.Y. 10011. 5½ x 8½ in., 224 pp. Paper, \$4.95.

One of the first books on the subject to take the important semiconductor voltmeter into account. Covers basic principles, the various types of vtvms and tvms, testing methods and special types (high-sensitivity voltmeters, microammeters and galvanometers).

SERVICING TRANSISTOR RECEIVERS, by F. R. Pettit. *Sim-Tech Book Co., P.O. Box 69, Agincourt, Ontario, Canada. 5½ x 8½ in., 96 pp. Paper, \$1.50.*

An interesting little book based on British practice. It contains several schematics of British transistor receivers of different types, and a couple of record players.

PRINCIPLES OF COLOUR TELEVISION, by G. N. Patchett. *Norman Price Publishers, Ltd., obtainable from Sim-Tech Book Co., P.O. Box 69, Agincourt, Ontario, Canada. 5½ x 8½ in., 128 pp. Paper, \$1.50.*

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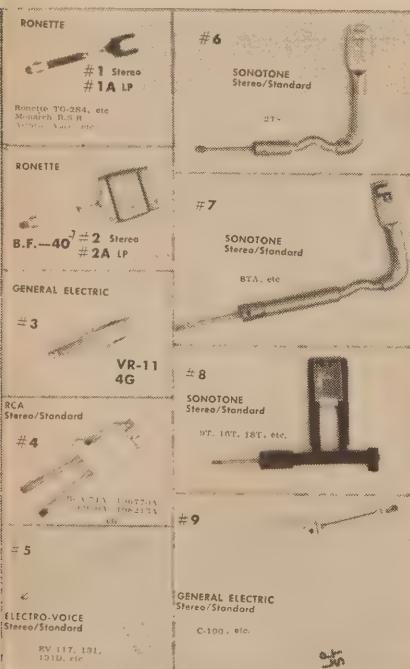
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Hill Book Co., Inc., 330 W. 42 St., New York, N.Y.
10036. 6 1/2 x 9 1/2 in., 653 pp. Cloth, \$11.95.

The latest edition of a well-known
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the latest advances in TV technology and
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RCA TRANSISTOR MANUAL. RCA Electronic Com-
ponents & Devices, Harrison, N.J. 5 1/2 x 8 1/2 in.,
384 pp. Paper, \$1.50.

The revised edition has 80 more pages
than the original *RCA Transistor Manual*.
The foreword explains that the technical
data section as well as the text material has
been brought up to date and expanded, and
that "many practical and timely additions"
have been made to the Circuit Section. In-
cludes transistors, rectifiers, SCR's, varac-
tors and tunnel diodes.

ELECTRONICS DATA HANDBOOK, By Martin
Clifford. Gernsback Library, Inc., 154 W. 14 St.,
New York, N.Y. 10011. 5 1/2 x 8 1/2 in., 160 pp.
Paper, \$2.95.

A plethora of formulas, definitions and
information on a "simply staggering"
amount of data, beginning with resistors in
series, going through wavelength and fre-
quency, vacuum tubes, transistors, antennas
and transmission lines, measurements and
tables to Lissajous figures for frequency
determination. Excellent appendixes, and
good illustrations including a list of elec-
tronics symbols, showing both communica-
tions and industrial versions.

PULSE TECHNOLOGY, by William A. Stanton.
John Wiley & Sons, Inc., 605 Third Ave., New
York 16, N.Y. 6 x 9 in., 255 pp. Cloth, \$7.

Discusses Boolean algebra and logic
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use of the oscilloscope to analyze and
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CIRCUITS, by Matthew Mandl. Prentice-Hall, Inc.,
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STANDARD GRAPHICAL SYMBOLS, by Alvin
Arnell. McGraw-Hill Book Co., Inc., 330 W. 42 St.,
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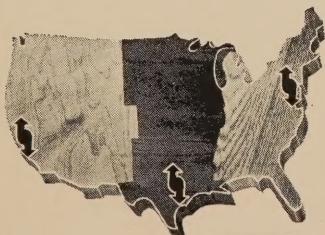
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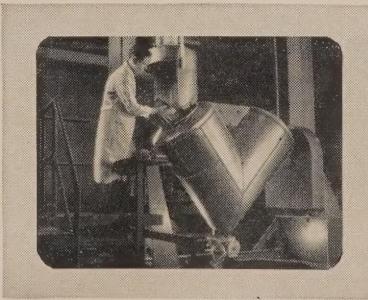
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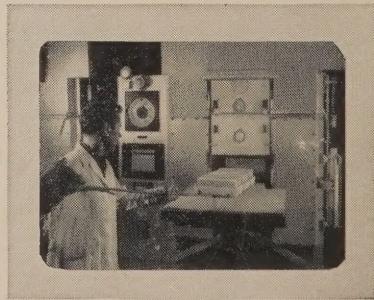
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